Association of Farming with COPD

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Association of Farming with COPD

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감사의 글

본 논문의 시작부터 맺기까지 언제나 관심과 지도 편달로 가르침을 주신 차봉석 교수님께 진심으로 감사 드립니다. 부족한 논문을 심사하시고 자상하게 다듬어 주신 장세진 교수님, 고상백 교수님, 김상하 교수님, 김형렬 교수님께 깊은 감사를 드립니다. 본 연구에 전념 할 수 있도록 이해와 협조를 해 주신 직업환경의학과 전공의 선생들과 모든 직원분들께도 감사 드립니다.

부족한 죄인을 구원하시고 목자되어 주셔서 변함없는 은혜와 사랑을 베풀어 주시는 하나님 아버지께 감사를 드립니다. 대학시절 성경을 가르쳐 주시고 예수님을 따르는 삶을 살 수 있도록 인도해 주신 연희센터의 김바나바 목자님과 김다윗 목자님께도 감사를 드리고 싶습니다.

마지막으로 저를 낳아 주시고 이 자리까지 오게 해주신 사랑하는 아버지, 어머니와 장인, 장모님, 큰형, 작은형 내외 그리고 항상 저의 뒷바라지에 여념이 없는 사랑하는 아내 권보윤과 사랑하는 두 아들 오승환, 오정환에게 이 부족한 논문을 바칩니다.

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Abstract

Association of Farming with COPD

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Objective: This study aims to investigate whether farming is an independent risk factor of Chronic obstructive pulmonary disease (COPD) subjects and what are risk factors of farmers with COPD in Korea.

Method: This cross-sectional study used data from the 2007 Korean Genomic Rural Cohort (KGRC) study. A total of 9,659 subjects underwent spirometry among 10,111 of the KGRC. COPD was defined as forced expiratory volume in 1 second (FEV_1)/ forced vital capacity (FVC) ratio is less than 70%. The study subjects were categorized into those with farming and non-farming occupations by re-classification after determining their occupations using Korea's Standard Occupation Classification System. Multiple logistic regression analysis were performed to compare various risk factors including metabolic markers and health behaviors of farmers with non-farmers.

Result: The prevalence in farmers and non-farmers were 16.7% and 7.2%, respectively. Notably, this study showed that farming is a significant independent risk factor (OR=1.44; 95% CI=1.18-1.75) after adjusting for other potential risk factors such as age, gender, education level, smoking, and body mass index (BMI). In farmers, C-reactive protein and HOMA-insulin resistance (IR) were significant factors compared with non-farmers. Metabolic markers including BMI, visceral fat, and HOMA-IR were significantly low in farmers with COPD compared with non farmers with COPD.

Conclusion: These findings indicate that farming is an independent risk factor of COPD and low body weight plays a significant role in developing COPD in farmers with COPD.

Key Words : COPD, Risk factor, Farming, Farmer, BMI, Emphysema

I. Introduction

Chronic obstructive pulmonary disease (COPD) is a important disease around the world in terms of prevalence and mortality. It is a critical disease from the public health perspective as it increasing and is expected to rank the fifth in the burden of disease in the world in 2020. In South Korea, the mortality rate due to COPD increased by 30% over 10 years. Among all cause of death, its ranking increased from the 10th in 1999 to the 7th in 2008 [Statistics Korea 2009].

The risk factors for COPD largely include genetic factor, gender, age, and social and environmental factors. The environmental factors are smoking, occupational hazardous agents, air pollution. 15-20% of COPD is related to occupation [Ameille et al. 2006].

The correlation between farming and COPD was first observed in the early 18th century, when Ramazzini reported that the exposure to dust in farming could cause respiratory disease [Ramazzini 1940]. Since then, many studies have been conducted, but most of them evaluated COPD according to exposure level, signs and symptoms [Holness et al. 1987; Donham et al. 1990; Choudat et al. 1994; Dosman et al. 1987; Dalphin et al. 1993; Babbott, Gump and MacPherson 1980]. No study has yet been conducted showing characteristics of COPD in farmers by investigating the metabolic markers and health behaviors of farmers with COPD.

COPD is observed to present in one of two main pathologic types, differing by the individuals. While obese COPD patients mainly have the chronic bronchitis type, thin ones tend to have the emphysema type [Annotator 1968; Ogawa et al. 2008].

The hypotheses of this study are as follows. First, the prevalence of COPD may be higher in farmers than in non-farmers in typical rural communities of South Korea. Second, the main pathologic type of COPD in farmers may be emphysema caused by the direct destruction of pulmonary tissues occurring due to respiratory hazardous agents rather than chronic bronchitis. Therefore, this study aims to investigate whether farming is an independent risk factor of COPD and what are risk factors of farmers with COPD in Korea.

II. Materials and Methods

1. Study subjects

The Korea Genomic Rural Cohort (KGRC) study was performed to assess health and nutrition conditions of Korean rural areas by the Korea Centers for Disease Control and Prevention (KCDC) in 2007. It surveyed Wonju, Pyeongchang, Gangneung, Geumsan and Naju and its subjects were adults aged over 30 years.

This study included 9,886 undergoing spirometry of the 10,111 subjects who participated in the cohort. They consisted of 4,004 males and 5,882 females. This study included a structured questionnaire, radiological test, and blood test, as well as spirometry. When those whose specific occupation was not recorded, those in the military, and those who were unskilled laborers in areas other than agriculture, forestry and fishery were excluded, the number of subjects was 7,497. A total of 7,221 persons were included in the multivariate analysis in the end by excluding those with missing data about related variables (Figure 1).

This study obtained written informed consent from all of the subjects and was approved by the Institutional Review Board (IRB) of Wonju College of Medicine, Yonsei University.

2. Variables and Measurement

2.1. Pulmonary Function Test (PFT)

Spirometry was conducted with dry rolling spirometers (Model 2130, SensorMedics, Yorba Linda, CA, USA) based on the guidelines of the American Thoracic Society (ATS)/ European Respiratory Society (ERS) [ATS/ ERS 2005] by three trained medical laboratory technologists.

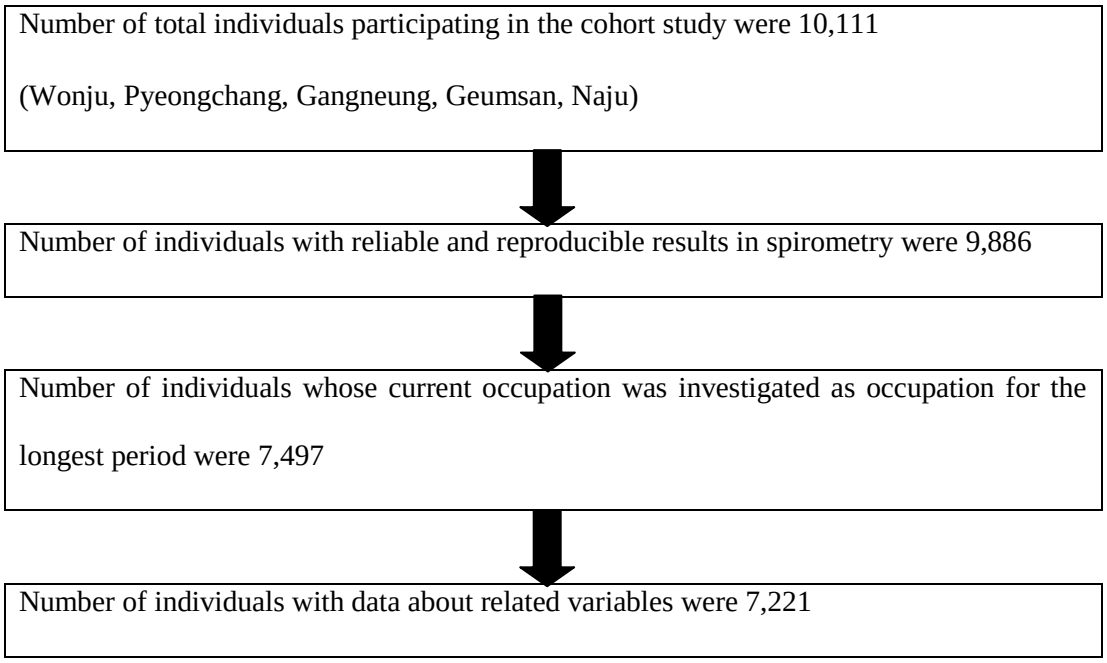

Figure 1. Selection process of subjects

2.2. Definition of COPD

COPD was defined as forced expiratory volume in 1 second (FEV_1)/ forced vital capacity (FVC) ratio is less than 70% by following the criterion presented in the Global Initiative for Chronic Obstructive Lung Disease (GOLD) and its stage was classified according to FEV_1% [NHLBI/WHO, 2006]. In other words, $FEV_1 \geq 80\%$, $50\% \leq FEV_1 < 80\%$, $30\% \leq FEV_1 < 50\%$ and $FEV_1 < 30\%$ were classified as stage I (mild COPD), stage II (moderate COPD), stage III (severe COPD) and stage IV (very severe), respectively.

2.3. Cigarette smoking

Smokers and non-smokers were difined as subjects smoking over 20 packs of cigarettes and less than 20 packs respectively, up to the time of the questionnaire survey. If smokers stopped smoking, they were classified as ex-smokers. For ex-smokers, the quitting age of smoking, the starting age of smoking, the mean number of cigarettes smoked per day, and the total smoking

period were examined. For current smokers, the starting age of smoking, the mean number of cigarettes smoked per day, and the total smoking period were also investigated. Based on the results, the subjects were divided into three categories (non-smokers, subjects smoking less than 20 pack-years, and those doing over 20 pack-years) for the analysis.

2.4. Occupational classification

Occupational history was examined with the following questions: 1) What job do you do now? 2) How long have you done it? 3) Have you had your current occupation longer than any other? 4) If not, what job did you do for the longest period of time? 5) When did you start and finish it?

A total of 7,221 subjects were confined as considering whether their current occupation was the one for the longest continued among spirometry-examined subjects (n=9,886). The classification of occupations was performed using the Korean Standard Classification of Occupations after adding housewife and domestic worker categories to it. They were subdivided into farmers and non-farmers (Table 1).

Table 1. Distribution of farmers and non-farmers

Unit; number (%)

Occupation	Total	Male	Female
Farmers	4,839 (67.0)	2,155 (79.4)	2,684 (59.5)
Non-farmers	2,382 (33.0)	558 (20.6)	1,824 (40.5)
Total	7,221 (100.0)	2,713 (100.0)	4,508 (100.0)

2.5. Body mass index

The BMI is calculated as body weight (kg) divided by the square of height (m^2). This study grouped the BMI into underweight (<18.5), normal (18.5-22.9), overweight (23-24.9), and obese ($\geq$25) groups, respectively.

2.6. Education level

Education level is a good index for evaluating socioeconomic level. This study grouped the education levels into low, middle, and high levels with graduation from elementary school and high school, respectively, as classification boundaries.

3. Statistical analysis

The total prevalence of COPD and the prevalence by farmers and non-farmers were investigated. The prevalence of chronic bronchitis and asthma diagnosed by physicians were examined.

To evaluate risk factors of COPD, logistic regression analysis was conducted after adjusting for other conrol variables. The trend was assessed according to changes in the odds ratios of farmers and non-farmers by working duration.

Univariate analysis on traditional risk factors, metabolic markers, and health behaviors of farmers and non farmers, respectively, were performed. HOMA IR, BMI, CRP, r-GTP and TG did not meet normality, so they were analyzed after log-transformation. Sequential multivariate analysis was performed by adjusting significant variables in univariate analysis. Model I was analyzed with traditional variables and model II was done by adding metabolic markers to the variables of model I. Model III was analyzed by adjusting health behavior factors along with those of model II.

Farmers and non farmers with COPD were compared. Continuous variables and nominal variables were analyzed with a t-test and chi-square test, respectively and the significance level was 0.05 with 95% confidence level.

III. Results

1. Prevalence and Risk Factors of COPD

The prevalence in farmers and non-farmers were 16.7% and 7.2%, respectively, and most of them were stage 1 (mild). On the other hand, the rates of chronic bronchitis and asthma diagnosed by physicians were low at 1.9% and 2.4%, respectively (Table 2).

Table 2. Prevalence of COPD[a]

Unit; number (%)

		Farmers	Non-Farmers
Total	7,221 (100.0)	4,839 (100.0)	2,382 (100.0)
Normal*	6,241 (86.4)	4,031 (83.3)	2,210 (92.8)
COPD	980 (13.6)	808 (16.7)	172 (7.2)
Stage I (mild)	696 (9.6)	579 (12.0)	117 (4.9)
Stage II (moderate)	254 (3.5)	205 (4.2)	49 (2.1)
Stage III (severe)	22 (0.4)	22 (0.5)	0 (0.0)
Stage IV (very severe)	3 (0.0)	2 (0.0)	1 (0.0)
Physician-diagnosed			
Chronic bronchitis	129 (1.9)	95 (2.1)	34 (1.5)
Asthma*	165 (2.4)	122 (2.7)	43 (1.9)
Spirometry, mean±SD[b]			
FEV_1 (%)[c]*	107.26±19.37	105.67±16.99	108.03±20.39
FVC (%)[d]*	100.42±15.81	97.62±13.85	101.80±16.51
FEV_1/ FVC (%)*	78.93±9.73	77.93±10.25	80.95±8.21

*$p<0.05$

[a] COPD: chronic obstructive pulmonary disease

[b] SD: standard deviation

[c] FEV_1: forced expiratory volume in 1 s, [d] FVC: forced volume capacity

For the risk factors of COPD, male, age over 65 years, smoking history of over 20 pack-years, low educational level, low BMI and farming occupation were found to be statistically significant factors even after adjusting other variables (Table 3).

Table 3. Risk factors of COPD[a]

Variables	COPD		Model I	Model II
	Yes	No	OR[b] (95% CI[c])	OR (95% CI)
Gender				
Female	343 (35.0)	4165 (66.7)	1.00	1.00
Male	637 (65.0)	2076 (33.3)	2.57 (2.07-3.20)	2.37 (1.85-3.02)
Age (year)				
<65	672 (68.6)	5190 (83.2)	1.00	1.00
≥65	308 (31.4)	1051 (16.8)	1.77 (1.50-2.09)	1.76 (1.48-2.10)
Smoking(p-y[d])				
None	486 (49.6)	4833 (77.4)	1.00	1.00
<20	103 (10.5)	494 (7.9)	1.08 (0.82-1.44)	1.07 (0.80-1.45)
≥20	391 (39.9)	914 (14.6)	2.07 (1.67-2.57)	2.07 (1.65-2.60)
Education				
≤Elementary	280 (28.6)	1387 (22.2)	2.12 (1.63-2.76)	1.81 (1.37-2.38)
Middle & high	565 (57.7)	3564 (57.1)	1.41 (1.13-1.76)	1.23 (0.97-1.56)
≥College	135 (13.8)	1290 (20.7)	1.00	1.00
BMI[e] (kg/m^2)				
<18.5	33 (3.5)	110 (1.8)	1.84 (1.19-2.83)	1.59 (0.98-2.55)
18.5-22.9	406 (42.7)	1841 (30.3)	1.83 (1.54-2.17)	1.64 (1.34-2.02)
23-24.9	237 (24.9)	1494 (24.6)	1.35 (1.12-1.64)	1.32 (1.08-1.63)
≥25	274 (28.8)	2631 (43.3)	1.00	1.00

Table 3. Risk factors of COPD[a] (continued)

Variables	COPD		Model I	Model II
	Yes	No	OR[b] (95% CI[c])	OR (95% CI)
Occupation				
Non-farming	172 (17.6)	2210 (35.4)	1.00	1.00
Farming	808 (82.4)	4031 (64.6)	1.44 (1.18-1.75)	1.16 (0.94-1.44)
Metabolic markers				
SBP[f]	130.56 (18.17)	131.21 (18.24)		0.99 (1.00-1.00)
DBP[g]	82.63 (10.96)	82.51 (11.92)		1.00 (0.99-1.01)
FBS[h]	97.32 (23.74)	96.78 (24.05)		1.00 (1.00-1.01)
HOMA IR[i]	1.82 (1.38)	2.10 (1.88)		0.92 (0.86-0.99)
Visceral fat	2.21 (0.97)	2.49 (2.94)		0.98 (0.94-1.02)
CRP[j]	2.52 (5.35)	1.82 (4.68)		1.20 (1.12-1.29)
r-GTP[k]	52.55 (115.33)	34.99 (78.69)		0.98 (0.88-1.10)
Adiponectin	9.07 (0.57)	9.11 (0.53)		1.07 (0.91-1.26)
T.chol[l]	197.34 (38.10)	204.83 (39.01)		0.99 (0.99-1.00)
HDL[m]	46.57 (11.94)	46.04 (10.89)		1.01 (1.00-1.02)
LDL[n]	113.38 (33.58)	120.51 (33.31)		1.01 (1.00-1.01)
TG[o]	156.01 (100.69)	154.47 (107.83)		1.23 (0.98-1.54)

Model I; adjusted gender, age, smoking, education, BMI and occupation

Model II; adjusted Model I+metabolic markers

[a] COPD: chronic obstructive pulmonary disease

[b] OR: odds ratio, [c] 95% CI: 95% confidence interval

[d] p-y: pack years

[e] BMI: body mass index, [f] SBP: systolic blood pressure, [g] DBP: diastolic blood pressure, [h] FBS: fasting blood sugar, [i] IR: insulin resistance, [j] CRP: C-reactive protein, [k] r-GTP: gamma glutamyl transpeptidase, [l] T.chol: total cholesterol, [m] HDL: high density lipoprotein, [n] LDL: low density lipoprotein, [o] TG: triglyceride

In particular, whether longer duration of working as farmers increased risk was evaluated by comparing farmers with non-farmers. Although no statistical significance was observed, while longer duration was associated with higher risk in farmers, the tendency was not found in non farmers (Table 4).

Table 4. Risk of COPD[a] by working duration

Unit; number (%)

	COPD	Normal	OR[b]	95% CI[c]
Farming (year)				
0-5	7 (0.9)	63 (1.6)	1.00	
6-30	159 (20.4)	1477 (37.9)	0.88	0.39-2.02
31-70	613 (78.7)	2480 (60.5)	1.60	0.71-3.64
Non-farming (year)				
0-5	8 (4.9)	116 (5.6)	1.00	
6-30	89 (54.6)	1281 (62.0)	1.13	0.50-2.55
31-70	66 (40.5)	670 (32.4)	1.57	0.68-3.67

Adjusted for gender, age, smoking, education, BMI

[a] COPD: chronic obstructive pulmonary disease

[b] OR: odds ratio, [c] 95% CI: 95% confidence interval

2. Comparison of Risk Factors of COPD in Farmers and Non-Farmers

Multivariate analysis was conducted by adjusting the traditional risk factors, metabolic markers and health behaviors, in that order. According to model III for farmers, male, age over 65 years, current smoking, educational level of elementary school graduate or lower, and normal or overweight BMI were significant among the traditional risk factors, and higher HOMA IR and higher CRP increased the risk of COPD among the metabolic markers. Exercise and alcohol-drinking history, which were different in univariate analysis, were not found to be significant after adjustment (Table 5).

In model III for non-farmers, male, age over 65 years, current smoking, and educational level of elementary school graduate or lower were significant among the traditional risk factors. However, unlike farmers, there was no significant factors among the BMI and metabolic markers (Table 6).

3. Characteristics of Farmer with COPD

The difference in their risk factors with farmers and non farmers with COPD was assessed through frequency matching of age and gender. Total Numbers are 525 subjects (363 farmers and 162 non-farmers). Severity of COPD showed no significant difference. Blood pressure, cholesterol, CRP, r-GTP, adiponectin and blood sugar among metabolic markers showed no significant difference. HOMA IR, BMI, and visceral fat among metabolic markers and exercise showed a statistically significant difference (Table 7).

Table 5. Odds ratio of risk factors for COPD[a] in farmers

	Model I	Model II	Model III
Traditional risk factors			
Gender			
Male	2.59 (2.04-3.31)	2.28 (1.76-2.96)	2.43 (1.86-3.18)
Age (yr)			
≥65	1.72 (1.43-2.07)	1.66 (1.38-2.00)	1.67 (1.38-2.01)
Smoking			
Past	1.13 (0.83-1.54)	1.10 (0.81-1.51)	1.14 (0.84-1.57)
Current	2.02 (1.60-2.55)	2.01 (1.58-2.55)	2.03 (1.59-2.58)
Education			
≤Elementary	1.84 (1.32-2.55)	1.76 (1.26-2.45)	1.73 (1.24-2.41)
Middle & high	1.25 (0.94-1.67)	1.21 (0.91-1.61)	1.19 (0.89-1.59)
BMI[b] (kg/m^2)			
<18.5	1.80 (1.13-2.86)	1.59 (0.98-2.59)	1.56 (0.96-2.53)
18.5-22.9	1.85 (1.52-2.25)	1.71 (1.37-2.14)	1.67 (1.34-2.09)
23-24.9	1.36 (1.09-1.70)	1.31 (1.05-1.65)	1.30 (1.03-1.63)
Metabolic markers			
HOMA IR[c]		0.78 (0.65-0.94)	0.78 (0.65-0.93)
Visceral fat		0.98 (0.94-1.02)	0.98 (0.94-1.02)
CRP[d]		1.21 (1.12-1.31)	1.21 (1.12-1.30)
r-GTP[e]		1.02 (0.91-1.14)	1.04 (0.93-1.17)
T.chol[f]		1.00 (0.99-1.00)	1.00 (0.99-1.01)
LDL[g]		1.00 (1.00-1.01)	1.00 (1.00-1.01)
Health behaviors			
Exercise			
Yes			0.91 (0.71-1.16)
Alcohol consumption			
Past			0.79 (0.58-1.08)
Current			0.83 (0.68-1.03)

Model I; adjusted traditional risk factors, Model II; adjusted model I+metabolic markers, Model III; adjusted model III+health behaviors

[a]COPD: chronic obstructive pulmonary disease

[b] BMI: body mass index, [c] IR: insulin resistance, [d] CRP: C-reactive protein, [e] r-GTP: gamma glutamyl transpeptidase, [f] T.cho: total cholesterol, [g] LDL: low density lipoprotein

Table 6. Odds ratio of risk factors for COPD[a] in non-farmers

	Model I	Model II	Model III
Traditional risk factors			
Gender			
Male	2.62 (1.54-4.44)	2.55 (1.46-4.44)	2.61 (1.49-4.60)
Age (yr)			
≥65	1.63 (1.02-2.63)	1.68 (1.04-2.72)	1.68 (1.04-2.74)
Smoking			
Past	0.80 (0.39-1.63)	0.70 (0.33-1.47)	0.72 (0.34-1.53)
Current	2.10 (1.19-3.70)	1.95 (1.09-3.47)	1.96 (1.09-3.51)
Education			
≤Elementary	2.41 (1.37-4.23)	2.20 (1.23-3.92)	2.16 (1.19-3.90)
Middle & high	1.49 (1.01-2.19)	1.43 (0.97-2.12)	1.41 (0.95-2.09)
BMI[b] (kg/m^2)			
<18.5	2.37 (0.66-8.48)	0.84 (0.16-4.37)	0.81 (0.15-4.27)
18.5-22.9	1.67 (1.13-2.45)	1.05 (0.57-1.94)	1.04 (0.56-1.91)
23-24.9	1.29 (0.85-1.94)	0.96 (0.59-1.58)	0.96 (0.58-1.57)
Metabolic markers			
HOMA IR[c]		0.70 (0.48-1.04)	0.71 (0.48-1.05)
Visceral fat		0.78 (0.57-1.06)	0.78 (0.57-1.06)
CRP[d]		1.11 (0.95-1.28)	1.10 (0.95-1.28)
r-GTP[e]		1.11 (0.86-1.43)	1.12 (0.86-1.45)
T.chol[f]		1.00 (1.00-1.01)	1.00 (0.99-1.01)
LDL[g]		1.00 (0.99-1.01)	1.00 (0.99-1.01)
Health behaviors			
Exercise			
Yes			0.98 (0.69-1.39)
Alcohol			
Past			1.16 (0.57-2.36)
Current			0.87 (0.59-1.31)

Model I; adjusted for traditional risk factors, Model II; adjusted for model I+metabolic markers, Model III; adjusted for model III+health behaviors

[a] COPD: chronic obstructive pulmonary disease

[b] BMI: body mass index, [c] IR: insulin resistance, [d] CRP: C-reactive protein, [e] r-GTP: gamma glutamyl transpeptidase, [f] T.cho: total cholesterol, [g] LDL: low density lipoprotein

Table 7. Difference in risk factors for COPD[a] between farmers and non-farmers

Total number of subjects (n=525)	Farmers (n=363)	Non-farmers (n=162)	p-value
COPD severity, number (%)			
Stage I (mild)	271 (74.7)	115 (71.0)	0.73
Stage II (moderate)	83 (22.9)	43 (26.5)	
Stage III (severe)	8 (2.2)	4 (2.5)	
Stage IV (very severe)	1 (0.3)	0 (0.0)	
Metabolic markers, mean (SD[b])			
SBP[c]	130.46 (18.56)	131.73 (18.38)	0.47
DBP[d]	82.86 (10.76)	83.96 (10.53)	0.27
FBS[e]	95.01 (17.12)	98.62 (31.91)	0.09
HOMA IR[f]	1.84 (1.39)	2.03 (1.18)	0.01*
HbA1C	5.69 (0.73)	5.61 (0.81)	0.27
BMI [g]	23.90 (3.00)	24.48 (3.26)	0.04*
Visceral fat	2.23 (0.90)	2.43 (0.94)	0.02*
CRP[h]	1.83 (3.64)	2.75 (7.15)	0.88
r-GTP[i]	38.52 (86.47)	27.10 (30.68)	0.20
Adiponectin, log	9.25 (0.51)	9.18 (0.49)	0.21
T.chol[j]	199.12 (39.84)	202.11 (37.84)	0.42
HDL[k]	46.77 (11.88)	47.12 (12.03)	0.76
LDL[l]	116.50 (34.35)	118.40 (33.97)	0.56
TG[m]	155.07 (109.99)	138.07 (76.88)	0.14
Health behaviors, number (%)			
Exercise			
Yes	58 (16.0)	64 (39.5)	0.00*
No	305 (84.0)	98 (60.5)	
Alcohol			
Non	200 (55.6)	105 (65.2)	0.12
Past	25 (6.9)	8 (5.0)	
Current	135 (37.5)	48 (29.8)	

* p-value<0.05

[a] COPD: chronic obstructive pulmonary disease

[b]SD: standard deviation

[c] SBP: systolic blood pressure, [d] DBP: diastolic blood pressure, [e] FBS: fasting blood sugar, [f] IR: insulin resistance, [g] BMI: body mass index, [h] CRP: C-reactive protein, [i] r-GTP: gamma glutamyl transpeptidase, [j] T.chol: total cholesterol,

[k] HDL: high density lipoprotein, [l] LDL: low density lipoprotein, [m] TG: triglyceride

IV. Discussion

Exposure to various organic and inorganic dusts during farming was one of the first recognized occupationally harmful factors. In 1955, Olaus Magnus warned against the risk of inhalation of grain dust and Ramazzini referred to the risk of grain dust in his book, *'Diseases of Workers'* [Ramazzini, 1940]. However, systemic studies on respiratory disease related to farming have been conducted since the 20th century when its problems were recognized. Because mainly mining and heavy industry had drawn attention in the occupational health sector, and farmers had been widely considered to be generally healthy, health problems related with farming had not been drawn sufficient recognition.

However, many harmful factors exist in farming and respiratory diseases are actually serious and have been widely observed. Although it can differ by country, the population with farming occupations is generally large. It is estimated to be 5 million in the U.S. and it is over 70% in developing countries. In South Korea, the official number of farmers are over one million [Statistics Korea 2011]. In addition, many studies have reported that the morbidity rate due to respiratory diseases is high and its mortality rate is significantly high compared to other diseases in farmers [Blair et al. 2005; Gassner and Spuhler 1995]. The risk of respiratory disease in farmers is high despite their low smoking rate, so it can be said to be an important issue from a public health perspective.

Farming can lead to exposure to various types of organic and inorganic dust and microorganisms, and respiratory diseases are frequently observed to varying degrees the farming occupation [ATS 1998]. This study only evaluated COPD.

In this study, the prevalence of COPD was 980 out of 7,221 (13.6%). The prevalence of farmers and non-farmers were 16.8% and 9.1%, respectively. When other known variables were adjusted for, COPD was found 1.4 times more in farmers than in non-farmers. Previous study also assessed COPD through objective spirometry with 2,200 subjects aged over 40 years from

2004 to 2005 and revealed that the odds ratios of farmers compared to non-farmers were 1.5 (1.1-2.0) and 1.8 (1.2-2.7) for GOLD stage I or higher and stage II or higher, respectively [Lamprecht et al. 2007]. The levels were similar to the findings of this study, and these results showed the high risk of COPD in farmers. Other studies on the correlation between occupation and COPD in the data of the National Health and Nutrition Examination Survey (NHANES) also found that the rate of COPD was higher in farmers [Hnizdo et al. 2002; Hnizdo et al. 2004].

Which factors provoke COPD more in farmers than in non-farmers? The factors generally known are age, smoking, obesity and socioeconomic level. Male is a risk factor only in developing countries and the difference by gender is known to be less in more developed countries. When the risk factors of COPD in farmers and non-farmers were investigated in this study, the traditional risk factors including age, gender, smoking and socioeconomic level were also significant risk factors.

For obesity or one of the traditional risk factors, the normal group with BMI of 18.5-23 was founded to have a higher COPD rate despite what is generally known. Moreover, obesity was not a significant risk factor in non-farmers. Moreover, low insulin resistance (HOMA-IR) and high CRP were found to be meaningful risk factors in farmers. However, as this study was a cross-sectional study, their causal relationship was not clearly determined. Nevertheless, the findings of this study suggest that the correlation of COPD with obesity and insulin resistance in farmers shows characteristics that differ from the characteristics of COPD in the general population.

To exclude a strong influence of smoking, farmers and non-farmers were compared only among non-smokers with COPD. The comparison also revealed that COPD in farmers was associated with a lower BMI and less visceral fat than in non-farmers. The farmers with COPD did less exercise and more alcohol drinking among health behaviors. CRP and r-GTP levels were lower in farmers than in non-farmers. CRP is generally known to be high in COPD patients and to be especially high in those with a low BMI [Pinto-Plata et al. 2006; Karadaq et al.

2008]. However, this study found that farmers with COPD had a lower CRP despite a lower BMI than non-farmers, and that was considered to be related to the severity of COPD rather than BMI itself. In other words, the severity of COPD was not largely different between farmers and non-farmers.

Based on all of these results, specifically, COPD was observed frequently in thin persons and it was more likely to appear as the emphysema type than the chronic bronchitis type [Annotator 1968; Ogawa et al. 2008]. The emphysema type has a pathogenesis from chronic exposure to dust. For example, when emphysema following smoking was investigated, dust in cigarette smoke such as aluminum silicate and kaolinite were found to be its causal materials [Girod and King 2005]. These are also in inorganic dust to which farmers are exposed frequently. That suggests that COPD in farmers, which is estimated to present as the emphysema type mainly in thin persons, is considerably affected by respiratory hazardous agents from the outside. Actually, a study on farmers with COPD and no smoking history in Europe revealed that dust and endotoxins had dose-response relationships with COPD [Monso et al. 2004].

Farming includes various types of work, from open field work in farmlands to green-house work and livestock related work. thus, the exposure to various harmful factors can occur. According to previous studies, organic and inorganic dust, microorganisms, gaseous materials, and fumes have an effect during farming. One study investigated the risk factors of chronic bronchitis in female farm workers without smoking history and showed that agricultural chemicals as well as grain dust and other various types of dust could cause the disease [Valcin et al. 2007]. In addition, the rate of respiratory symptoms was high in farmers working in the livestock industry and ammonia, hydrogen sulfide and organic and inorganic dust were shown to be causal materials [Eduard, Pearce and Douwes 2009].

In particular, because Korean farmers typically do multiple types of farm work, evaluation of the exposure level to an individual hazardous agent is impossible, but the comparison of clinical results such as those of this study implies that the exposure to various respiratory hazardous

agents has an influence.

The strengths of this study is that it was performed with a nation wide samples in typical rural communities of South Korea, and that it evaluated COPD based on the results of objectively reliable spirometry.

A limitation of this study was that it was a cross-sectional study so that it could not determine a causal relationship clearly. In addition, there could be an error in the classification of occupations. However, to reduce the error caused by occupational classification, some occupations provoking confusion were excluded. As farming includes various types of work, it would be appropriate to analyze the data separately according to each kind of task. However, farm work in South Korea is typically complex and the WHO defines farming by including all the various kinds of farming tasks, so the results of this study can be more useful in providing basic data for preventive measures through public health interventions.

V. Conclusion

From this study, I found that farming plays a pivotal role in increasing the risk of COPD. In addition, low body weight is a significant risk factor in farmers with COPD.

Farmers with COPD mainly present with the emphysema type without obesity, and they are considered to have been affected by hazardous agents in the occupational environment and by nutritional deficiency.

Their results indicate that it is strongly required that the agricultural policy to manage agricultural work for reducing the risk of COPD should be established.

References

Ameille J, Dalphin JC, Descatha A, Pairon JC. Occupational chronic obstructive pulmonary disease: a poorly understood disease. *Rev Mal Respir* 2006;23(4 Suppl):13S 119-130.

ATS/ERS Task Force. Standardization of lung function testing. *Eur Respir J* 2005;26:319-338.

American Thoracic Society. Respiratory health hazards in agriculture. *Am J Respir Crit Care Med* 1998;158:S1-S76.

Annotator. Blue bloater: pink puffer. *Br Med J* 1968;2:677.

Blair A, Sandler DP, Tarone R, Lubin J, Thomas K, Hoppin JA, Samanic C, Coble J, Kamel F, Knott C, Dosemeci M, Zahm SH, Lynch CF, Rothman N, Alavanja MC. Mortality among participants in the Agricultural Health Study. *AEP* 2005;15:279-285.

Babbott FL, Gump DW, Sylvester DL, MacPherson BV, Holly C. Respiratory symptoms and lung function in a sample of Vermont dairymen and industrial workers. *Am J Public Health* 1980;70:241-245.

Choudat D, Goehen M, Korobaeff M, Boulet A, Dewitte JD, Martin MH. Respiratory symptoms and bronchial reactivity among pig and dairy farmers. *Scand J Work Environ Health* 1994;20:48-54.

Donham KI, Merchant JA, Lassise D, Popendorf WJ, Burmeister LF. Preventing respiratory disease in swine confinement workers: Intervention through applied epidemiology, education and consultation. *Am J Ind Med* 1990;18:241-261.

Dosman JA, Graham BL, Hall D, Van Loon P, Bhasin P, Froh F. Respiratory symptoms and pulmonary function in farmers. *J Occup Med* 1987;29:38-43.

Dalphin JC, Pernet D, Dubiez A, Debieuvre D, Allemand H, Depierre A. Etiologic factors of chronic bronchitis in dairy farmers: case control study in the Doubs region of France. *Chest* 1993;103:417-421.

Eduard W, Pearce N, Douwes J. Chronic bronchitis, COPD, and lung function in farmers. *Chest*

2009;136:716-725.

Gassner M, Spuhler T. Why do farmers die more often from lung diseases?. *Schweiz Med Wochenschr* 1995;125:667-675.

Girod CE, King TE. COPD, a dust-induced disease?. *Chest* 2005;128:3055-3064.

Hnizdo E, Sullivan PA, Bang KM, Wagner G. Association between chronic obstructive pulmonary disease and employment by industry and occupation in the US population: a study of data from the Third National Health and Nutrition Examination Survey. *Am J Epidemiol* 2002;156(8):738-746.

Hnizdo E, Sullivan PA, Bang KM, Wagner G. Airflow obstruction attributable to work in industry and occupation among U.S. race/ethnic groups: a study of NHANES III data. *Am J Ind Med* 2004;46(2):126-135.

Holness DI, O'Blenis FL, Sass-Kortsak A, Pilger C, Nethercott JR. Respiratory effects and dust exposures in hog confinement farming. *Am J Ind Med* 1987;11:571-580.

Karadaq F, Kirdar S, Karul AB, Ceylan E. The value of C-reactive protein as a marker of systemic inflammation in stable chronic obstructive pulmonary disease. *Eur J Intern Med* 2008;19(2):104-108.

Lamprecht B, Schirnhofer L, Kaiser B, Studnicka M, Buist AS. Farming and the prevalence of non-reversible airway obstruction-results from a population-based study. *Am J. Ind. Med* 2007;50:421-426.

Monso E, Riu E, Radon K, Maqarolas R, Danuser B, Iversen M, Morera J, Nowak D. Chronic obstructive pulmonary disease in never-smoking animal farmers working inside confinement buildings. *Am J Ind Med* 2004;46(4):357-362.

NHLBI/WHO Global initiative for chronic obstructive lung disease (GOLD). Global strategy for the diagnosis, management and prevention of chronic obstructive lung disease(updated 2006). Available at: http://www.goldcopd.com (accessed 22.04.11).

Ogawa E, Nakano Y, Ohara T, Muro S, Hirai T, Sato S, Sakai H, Tsukino M, Kinose D,

Nishioka M, Niimi A, Chin K, Pare P D, Mishima M. Body mass index in male patients with COPD: correlation with low attenuation areas on CT. *Thorax* 2009;64:20-25.

Pinto-Plata VM, Hullerova H, Toso JF, Feudjo-Tepie M, Soriano JB, Vessey RS. C-reactive protein in patients with COPD, control smokers and non-smokers. *Thorax* 2006;61:23-28.

Ramazzini B. De morbis artificium Bernardini Ramazzini diatribe[Diseases of workers]. The Latin text of 1713 revised with translation and notes by Wilmer Cave Wright. The University of Chicago Press. Chicago. 1940.

Statistics Korea. 2009. http://www.kostat.go.kr. Accessed: 22 April, 2011.

Statistics Korea. 2011. http://www.kostat.go.kr. Accessed: 25 April, 2011.

Valcin M, Henneberger PK, Kullman GJ, Umbach DM, London SJ, Alavanja M.CR, Sandler DP, Hoppin JA. Chronic bronchitis among non-smoking farm women in the agricultural health study. *J Occup Environ Med* 2007;49(5):574-583.

국문요약

농작업과 만성폐쇄성폐질환간의 관련성

연구목적 : 이 연구는 한국의 농촌지역사회에서 만성폐쇄성폐질환의 위험요인을 찾아내고, 만성폐쇄성폐질환을 가진 농작업자들의 위험요인 및 특성을 탐구하고자 시행되었다.

연구방법 : 이 연구는 2005년부터 2008년까지 시행된 제1차 한국농촌유전체코호트의 자료를 가지고 시행된 단면연구이다. 센터를 방문하여 검사를 받은 대상자는 총 10,111명이었으며, 이 중에서 신뢰할만한 폐기능 검사값을 가진 대상자는 9,659명이었다. 만성폐쇄성폐질환의 정의는 FEV1/ FVC< 70%으로 하였다. 직업군의 분류는 처음에 조사된 한국표준직업분류를 가지고 호흡기 유해인자의 노출에 따라서 재분류를 하여 최종적으로 7,221명의 농작업군과 비농작업군으로 나누어 분석하였다. 다변량 로지스틱 회귀분석을 통하여 비차비를 산출하였고, 농작업군과 비농작업군의 위험요인에 있어서 차이가 있는지를 보았다. 또한 만성폐쇄성폐질환 사례만을 가지고 만성폐쇄성폐질환이 있는 농작업군과 비농작업군의 여러가지 특성을 비교하였다.

결과 : 농작업자에서의 만성폐쇄성폐질환의 유병률은 16.7%였다. 특별히 본 연구에서 다른 위험요인들을 보정한 후에도 농작업군이 독립적인 위험요인이었다 (OR=1.44; 95% CI=1.18−1.75). 농작업군과 비농작업군의 위험요인들을 비교하였을 때, 농작업군에서만 낮은 비만도, 낮은 인슐린저항성, 높은 CRP 등이 의미있

는 위험요인이었다. 만성폐쇄성폐질환 사례만을 가지고 비교해 보았을 때 농작업군은 비농작업군에 비하여 비만도, 인슐린저항성, 내장비만이 의미있게 낮았다 ($p<0.05$).

결론 : 이러한 결과들은 농작업이 농촌지역사회에서 만성폐쇄성폐질환의 독립적인 위험요인이됨을 나타내준다. 그리고 만성폐쇄성폐질환을 가진 농작업자들은 체중이 낮은 마른 사람들이 많으며, 이는 폐기종 형태의 만성폐쇄성폐질환이 우세하다는 것을 나타내준다. 폐기종은 영양결핍과 외부의 호흡기 유해인자의 직접적인 영향을 받는 것으로 알려져 있으므로, 농작업자들을 호흡기질환으로부터 보호하고 예방하기 위하여 영양과 호흡기 유해인자에 대한 예방적 개입이 필요하다.

핵심어 : 만성폐쇄성폐질환, 위험요인, 농작업, 농작업자, 비만도, 폐기종