Worksite Wellness Program for Respiratory Disease Prevention in Heavy-Construction Workers

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Objective: To describe a respiratory disease prevention program in a US heavy-construction company. **Methods:** The program uses periodic spirometry and questionnaires and is integrated into a worksite wellness program involving individualized intervention. Spirometry Longitudinal Data Analysis (SPIROLA) technology is used to assist the physician with (i) management and evaluation of longitudinal spirometry and questionnaire data; (ii) designing, recoding, and implementing intervention; and (iii) evaluation of impact of the intervention. Preintervention data provide benchmark results. **Results:** Preintervention results on 1224 workers with 5 or more years of follow-up showed that the mean rate of FEV_1 decline was 47 mL/year. Age-stratified prevalence of moderate airflow obstruction was higher than that for the US population. **Conclusion:** Preintervention results indicate the need for respiratory disease prevention in this construction workforce and provide a benchmark for future evaluation of the intervention.

With escalating health care costs, workplace-integrated health, safety, and productivity management programs are increasingly identified as important components for improving workforce health-related costs.[1,2] Traditional medical screening (cross-sectional evaluation) and monitoring (longitudinal evaluation) at workplace are intended to identify work-related disease occurrence early in progression when intervention can have a beneficial impact on preventing progression of the disease.[3] Worksite wellness programs, on the other hand, are directed at promoting healthy lifestyle habits and are designed to avert the occurrence and progression of lifestyle-related diseases.[4] In an integrated health and safety program, primary prevention would include occupational safety (ie, prevention of occupational exposure) and encouragement of healthy lifestyle (eg, exercise, fitness, healthy eating habits, weight and stress management, smoking cessation programs, and smoke-free workplace).[5] Secondary prevention would be directed at individuals at high risk because of certain occupational exposure or activities (eg, workers need to wear respirators), lifestyle, or abnormal biometric values (eg, high cholesterol, excessive decline in lung function). Tertiary prevention is directed at individuals with existing ailment (eg, asthma, chronic obstructive pulmonary disease [COPD], cardiovascular disease). Integration of traditional medical screening with health promotion and behavior modification may be useful in fostering workers' participation in occupational safety as well as in health-promoting activities.[5]

In occupational settings with exposure to respiratory hazards, maintaining workers' respiratory health is important for reducing companies' and individuals' health-related costs.[6,7] Population- and industry-based epidemiologic studies continue to demonstrate that occupational exposure contributes to the development and severity of chronic respiratory diseases in worker populations, including heavy-construction workers.[8–19] Furthermore, the combined effect of workplace respiratory hazards and tobacco smoking increases the risk of COPD above what would be expected from the additive effects of the individual exposures.[19] Individuals who develop COPD are more likely to retire early, are less likely to participate in the labor force, and have increased morbidity and mortality.[20–22]

Periodic spirometry and respiratory symptoms questionnaire are the recommended screening methods for work-related respiratory diseases.[3,23–30] In the US periodic spirometry and medical questionnaire, data are collected on workers potentially exposed to respiratory hazards (eg, firefighters, construction workers) to ensure their fitness to wear respiratory personal protective equipment. Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) require or recommend periodic spirometry testing for workers exposed to certain respiratory hazards (asbestos, coke oven emissions, cadmium, cotton dust, formaldehyde, silica, and underground miners).[28–30] High prevalence of work-related respiratory abnormalities in World Trade Center rescue and recovery workers and in US popcorn production workers led to the establishment of spirometry-based health-monitoring programs in these groups of workers.[31,32] However, although many workplaces conduct periodic spirometry, there are no clear OSHA or NIOSH guidelines on their use for prevention. Epidemiologic evidence is needed on the usefulness of periodic spirometry and questionnaires for respiratory disease prevention at workplace.[33]

The objective of this report is to describe development of a computerized prevention program for respiratory disease and its integration into an existing worksite wellness/behavior change program in a US heavy-construction company. We outline the existing worksite wellness program and the newly integrated respiratory prevention program and present results on the current respiratory health of the workforce to provide a framework for the prevention program and benchmark data against which to evaluate its impact.

MATERIAL AND METHODS

Company's Existing Medical Screening and Worksite Wellness Program

The construction company's worksite wellness program and medical screening are available to its approximately 2000 workers involved in building bridges, road works, and construction of large buildings across north eastern states of the United States.[34] The program is supported by the company management, medical staff, and the workers.[34] The program involves (i) a voluntary health behavior change program including a Health Risk Appraisal that involves periodic monitoring of indices of metabolic syndrome and cardiovascular health (blood pressure, cholesterol, weight, body mass index BMI]) in approximately 80% of the workforce that is followed up multiple times per year with an on-site individualized health-coaching intervention directed at sustainable behavior change to prevent nonoccupational chronic disease; (ii) annual questionnaire survey of respiratory symptoms, respiratory disease, and occupational exposures; and (iii) triannual spirometry and annual audiometric examination.

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A company physician also uses the medical information from the respiratory disease screening to identify workers at risk of developing preventable respiratory disease, who may benefit from a referral to health coaching, on-site safety evaluation, a referral to one's personal physician, or an intervention to prevent development of occupational respiratory diseases. In both occupational and nonoccupational situations, an individualized wellness plan acceptable to a worker is developed in conjunction with a trained health coach and the worker. The role of the health coach is to guide, motivate, and support employees toward health behavior change and assist the worker with adherence to the wellness plan. The participants being coached are seen an average of 3.5 times per year by the coaches. The individual's Health Risk Appraisal information, risk score, wellness plan, and progress over time are all documented in the health care provider's Wellness Works Tracking System® software. Measurements from spirometry and audiometry are computerized in the Occupational Health Manager (OHM)® database and hard copies of annual questionnaires are filed in the medical files. Since its introduction, the worksite wellness program has led to substantial reduction in at-risk health behavior and in medical cost for the company (cost per employee dropped 10% in 2008 and 15% in 2009) resulting in millions of dollars saved annually by the company.[34]

Spirometry-Based Medical Screening and Monitoring

Although the spirometry measurements have been collected since 1990, their use for prevention purposes was limited, primarily because of lack of guidelines on how to use the data for prevention and lack of convenient procedures for longitudinal spirometry data evaluation. The use of the Spirometry Longitudinal Data Analysis (SPIROLA) software[35,36] since 2006 enabled the physician to appraise the potential usefulness of the periodic spirometry data for screening and monitoring purposes and resulted in an intervention on spirometry quality.

The company contracts two van services to conduct their spirometry testing. As part of the intervention on spirometry quality, a questionnaire survey of the two van services that provide most spirometry testing was conducted in 2008 by NIOSH to establish adherence to American Thoracic Society (ATS) and European Respiratory Society (ERS) recommendations for lung function testing.[37] Results indicated that the testing services were in compliance with the equipment and testing procedure recommendations. The program manager took the NIOSH-Approved Spirometry Training Course in 2008[38] to enhance capacity to review spirometry test quality.

Because of the triannual spirometry testing, between 400 and 700 workers undergo spirometry testing every year during the summer months. Subsequently, the physician uses SPIROLA's visual and analytical tools to screen for individuals whose lung function test results require further investigation, that is, those who are potentially at risk of developing respiratory impairment. This includes the following individuals: (i) those whose most recent lung function tests (forced expiratory volume in one second [FEV_1], forced vital capacity [FVC], or FEV_1/FVC ratio) are below the lower limit of normal (LLN) based on US population-based reference values[39,40] and (ii) those whose rate of FEV_1 decline is potentially excessive.[27,41]

Figure 1 illustrates an example of the visual and analytical assessment as facilitated by SPIROLA for the evaluation of longitudinal lung function changes. The figure shows charts for FEV_1, FVC, the percent predicted values and the observed FEV_1/FVC ratio, and the summary results. The observed FEV_1 and FVC data (dots) are interpreted in relation to a fitted linear regression line, and population-based cross-sectional reference equations (ie, LLN, which corresponds to the lower 5th percentile, and the lower 0.1th percentile [ie, ≈60% predicted]). The shorter solid line below the FEV_1 data points represents the limit of longitudinal decline that is used to identify the FEV_1 values that decline excessively from an established baseline during the first 1 to 7 years of follow-up.[27,41–44] The user can adjust the limit of longitudinal decline to make it more or less stringent, depending on the data variability and also the type of exposure involved; the recommended annual decline limit ranges from 10% to 15%.[27,41–44] From 8 years of follow-up, the estimated linear regression line and the lower 95% confidence limit indicate whether the individual is at risk of developing lung function impairment (ie, FEV_1, FVC, or FEV/FVC below LLN or 0.1th percentile). The right axis on the FEV_1 chart monitors the rate of FEV_1 change from the fourth year of follow-up. The longitudinal evaluation helps to take into account the level of lung function as well as the rate of decline since both are important in predicting the risk of future impairment.[24,27,41]

The first step in the decision-making process involves assurance of spirometry quality through the review of both longitudinal charts and the individual's spirometry tracings for potential spirometry test quality issues. Where needed, individuals should be retested to confirm the results and to improve spirometry data precision. When the spirometry quality does not comply with the ATS/ERS standards, the testing service should be informed. Dependent on satisfactory spirometry data quality, the individuals with excessive decline in lung function can be selected for intervention or referred to personal physicians.

Medical Questionnaire-Based Screening

The annual respiratory symptoms questionnaire (ie, adopted OSHA silica questionnaire) includes also questions to ascertain occupational history, smoking habits, and welding-associated symptoms. The questionnaire responses are used for screening for chronic bronchitis, asthma, wheezing, shortness of breath, and welding-related symptoms. Since 2010, the questionnaire has been adapted to allow electronic scanning of the responses and integration of questionnaire responses with longitudinal spirometry results for decision making and epidemiological evaluation.

Outline of the Respiratory Disease Prevention Program

The general respiratory disease prevention strategy for the workforce includes primarily occupational safety assessment at workplace and developing safety measures for exposure prevention, lifestyle intervention on smoking or weight control, and disease management. Table 1 outlines the main features of the intervention strategy as designed by the physician in conjunction with the company management. The strategy is computerized in SPIROLA to enable the physician to apply the relevant components of the strategy when developing individuals' intervention plans.

When designing an individual worker's intervention plan, the physician can review the individual's computerized longitudinal spirometry data, responses to annual questionnaires, occupational history, smoking habits, and weight change. Depending on the information, the physician can request the following "Type of Intervention": workplace assessment or interventions (Table 1, #1–4), lifestyle interventions (Table 1, #5), disease management (Table 1, #6), or clinical evaluation for personal protective equipment (Table 1, #7). The individuals' intervention plans are then sent electronically to the health coaches or workplace safety officers who carry out the specific actions and specific evaluations according to the intervention plan (Table 1). The health coaches' focus is mainly on prevention of lifestyle factors through behavior changes (eg, smoking habits, regular exercise, and weight control), whereas workplace safety officers are focused on prevention of occupational exposure (eg, engineering methods, change in individual's working habits). Both the health coaches and safety officers document changes that occurred in response to the proposed intervention plan and score Adherence and Success of the plan, using computerized forms. At

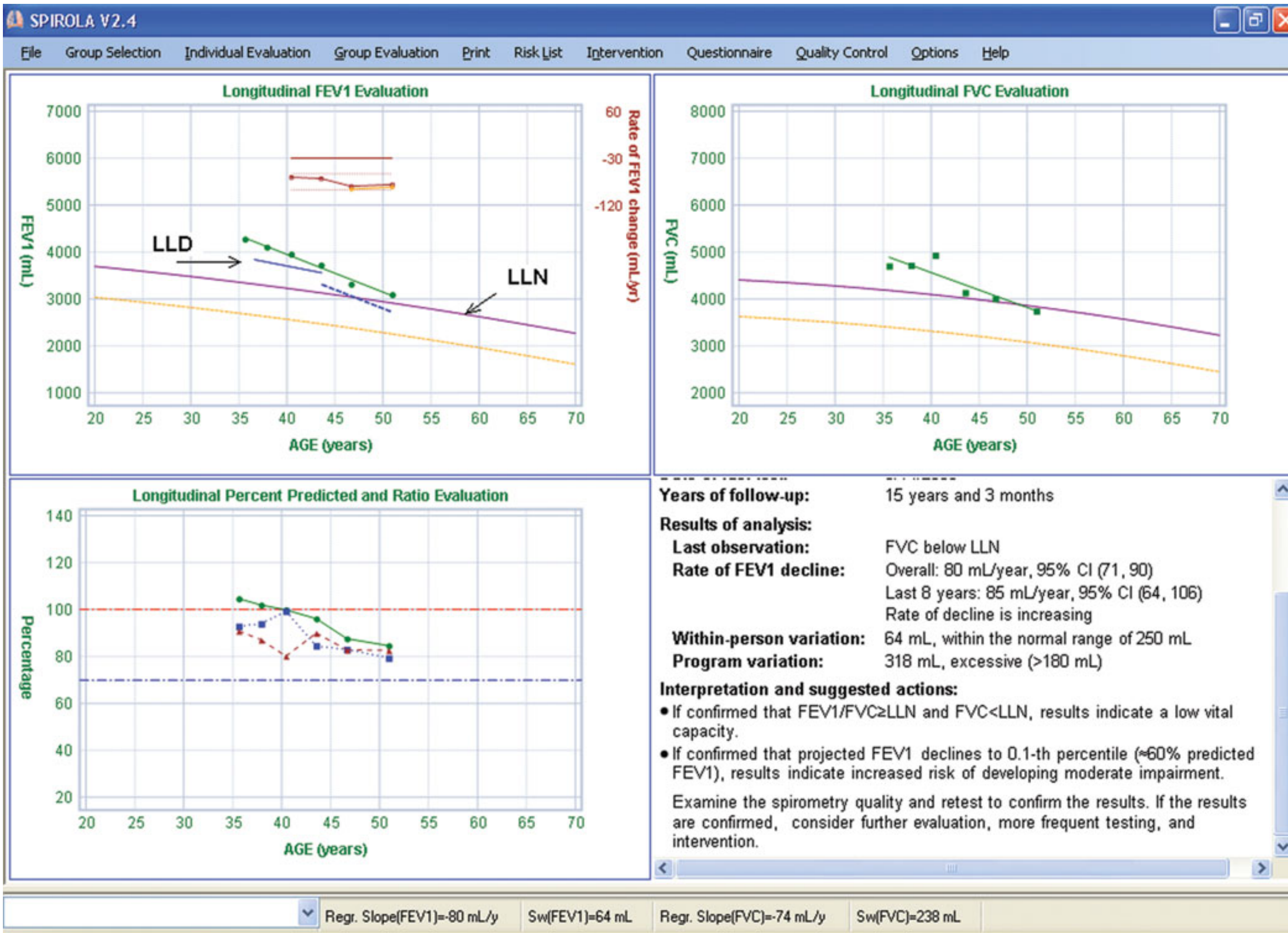

FIGURE 1. SPIROLA's chart for longitudinal spirometry data for an individual whose FEV_1 and FVC both show excessive decline from 35 years of age.

completion, the forms are electronically processed and results added to SPIROLA database to be used for evaluation of the intervention.

The infrastructure of the program described earlier has been piloted since 2008 and the respiratory prevention program was initiated in January 2010.

DATA ANALYSIS

Preliminary Longitudinal and Cross-sectional Data Analysis

To describe the preintervention spirometry data, we analyzed the longitudinal spirometry data collected from 1990 through the year 2009 in workers who had at least two follow-up tests, five or more years of follow-up, and the most recent spirometry test after the year 2000. We estimated each person's rate of FEV_1 and FVC decline associated with age, adjusted for height, by the linear regression model. Using the most recent tests, we calculated the age-specific percentage of moderate airflow obstruction (AO), defined as $FEV_1/FVC < LLN$ and $FEV_1 < LLN$ using US reference equations.[40] The percentages of AO were then compared to published prevalence of moderate AO estimated the same way for the US population by using NHANES III data.[45] Because the smoking data were collected only from 2008, we used the most recent spirometry measurements in these individuals to describe the effect of tobacco smoking (yes/no) and BMI index categories on the level of lung function. The percent predicted values, stratified by the smoking or BMI category, were plotted against age.

We also performed cross-sectional evaluation of all workers who performed lung function testing in the year 2008 to establish the prevalence of AO and excessive decline, observed per year in the workforce. The focus of prevention was to initiate intervention in individuals with excessive decline established over 6 or more years of spirometry follow-up. To assess the impact of data quality on identification of excessive decliners, the spirometry tracings were visually reviewed for technical quality by one of the coauthors (L.B.-W.) for individuals identified by SPIROLA to have excessive decline. The quality review consisted of three evaluations: (1) whether the FEV_1 and FVC tests were in compliance with the 2005 ATS/ERS test procedure recommendations for maneuver acceptability and test repeatability, (2) whether the interpretation would change if the test met 2005 ATS/ERS guidelines, and (3) whether the reported FEV_1 and FVC test values could affect longitudinal decline determinations.

RESULTS

Table 2 shows descriptive statistics of workers who had at least two follow-up tests, five or more years of follow-up, and the last spirometry test after the year 2000. There were 1224 male workers who satisfied those criteria; only a small number of female workers satisfied the criteria and these are not included in the analysis. Of

TABLE 1. General Intervention Strategy for the Construction Company Used for Developing Individual or Group Intervention Plans for Respiratory Disease Prevention

Type of Intervention	Specific Action Requested	Specific Evaluations
1. Occupational safety assessment	a. On-site current exposure IH assessment	i. Current exposure to dust, fumes, solvents, etc
		ii. Adequacy of current exposure control
		iii. Adequacy of current work practices
		iv. Use of respiratory personal protective equipment and training
	b. Air sampling to be done	Sampling results within limits
	c. Evaluate job category sampling history	i. Exposure levels above OSHA PEL
		ii. Exposure levels above NIOSH REL
	d. Recommend controls/modification	i. Current work practices
		ii. Whole work area
2. Additional education/training	Recommend additional training for individual(s)/group	
3. Repeat respiratory fit testing	Recommend repeat of respirator fit testing	
4. Work modification agreement	To be developed by safety personnel and worker(s)	
5. Lifestyle interventions	a. Smoking cessation referral to health coach or other	i. Nicotine replacement therapy (patch, nebulizer, gum)
		ii. Other methods of smoking cessation
	b. Weight loss referral	i. Referral to health coach: general nutritional advice, nutritional protocol, group therapy, commercial referral, other
		ii. Other referral: personal trainer, physician, dietician, commercial referral, other
	c. Activities/exercise	Referral to health coach/personal trainer/self directed: level of activity mild, moderate, strenuous
6. Disease management	a. Referral to health coach	
	b. Referral to own physician (asthma, chronic obstructive pulmonary disease, pneumoconiosis, hypersensitivity pneumonitis)	
7. Clinic intervention	Respiratory fitness for respirator personal protective equipment clinical evaluation	

these male workers, 94% were whites, 2.5% were African American, and 4% were Mexican American.

The mean age at first spirometry test was 34.4 years and the mean duration of spirometry follow-up was 9.2 years. At the most recent spirometry test, the largest proportion of the workers was in the 40–49 age category (35%). The mean percent predicted FEV_1 decreased over the follow-up from 97.2% to 91.2%, and a similar decline was observed for FVC. The estimated mean rate of FEV_1 and FVC decline was 47 mL/year, higher than what would be expected in healthy nonsmokers (ie, approximately 30 mL/year).[46] The percentage with moderate AO was higher than that expected for the general US population, for all age categories (Table 2). The mean BMI (kg/m^2) increased over the follow-up from 27.3 to 28.8 kg/m^2 and at the end of the follow-up, about 33.3% of the workers had BMI 30 or more and 9.8% had more than 35. The smoking status, recorded in SPIROLA since 2008, was available only on 544 workers (44.4%); of these, 421 (77.6%) reported being nonsmokers and 119 (22.4%) being smokers.

Using the most recent lung function measurements, we evaluated the effect of BMI on lung function in the 1224 individuals, and using the 544 individuals who had smoking data, we evaluated the effect of smoking. Figure 2 shows the mean percent predicted FEV_1, FVC, and the FEV_1/FVC ratio plotted against age, stratified by smoking categories (current smoker, nonsmoker). Smokers in comparison with nonsmokers had visibly lower mean percent predicted FEV_1 starting already around 30 years of age, but even nonsmokers had a gradual decline with age (Fig. 2A). As expected, FVC appears to be less affected by smoking than FEV_1 (Fig. 2B), which was reflected in the substantially lower mean FEV_1/FVC ratio in smokers (Fig. 2C). By about 50 years of age, the mean FEV_1/FVC ratio reached approximately 70% in smokers, a level associated with an obstructive impairment.[47,48]

Figure 3 shows the lung function results stratified by BMI categories (20–25, 26–30, 31–34, and $\geq$35). Those with BMI more than 35 showed substantial decrease in FEV_1 with increasing age (Fig. 3A). The "normal" 20–25 BMI category shows a steeper FEV_1 decline after 50 years of age than the other categories. For FVC, there is a gradual decrease with increasing BMI category, and the effect is particularly pronounced in those with BMI more than 35 (Fig. 3B). The larger effect of BMI on FVC than on FEV_1 is reflected in the increasing FEV_1/FVC ratio with increasing BMI, that is, a restrictive effect (Fig. 3C). The gradual decline in the FEV_1/FVC ratio in the "normal" 20–25 BMI category may be due to the effect of smoking, as smoking was associated with substantially lower mean BMI in the older age category and with an obstructive effect (Fig. 2C). Also, the percentage of smokers decreased with increasing BMI category from 30% in the "normal" 20–25 BMI category to 22%, 18%, and 12%, respectively.

Of the whole workforce, 658 workers had their triannual spirometry tests done during the year 2008. Of these, 8.3% had spirometry results consistent with moderate AO. For the 271 (41%) who had two or more years of follow-up, the mean rate of FEV_1 decline was 47 mL/year, and the mean within-person variation (ie, the standard deviation from the predicted regression line) was 255 mL. Of the 271 workers, 69 (25.5%) were identified by SPIROLA as having potentially excessive decline using either the limit of

TABLE 2. Descriptive Statistics for Construction Workers Who Had Two or More Follow-up Measurements Five or More Years Apart and Most Recent Measurements After Year 2000

	Male Construction Workers (N = 1224)	
Characteristic	**Mean**	**S.D. (Range)**
Age at baseline	34.4	9.7 (18–60)
Follow-up (yrs)	9.2	3.2 (5–18)
Height at baseline (cm)	177.7	6.9 (145–197)
% $PFEV_1$ baseline	97.2	14.8 (40–151)
% $PFEV_1$ follow-up	91.2	14.7 (36–148)
% PFVC baseline	99.1	13.6 (55–154)
% PFVC follow-up	93.6	13.5 (53–149)
Ratio baseline (%)	79.4	7.3 (33–99)
Ratio follow-up (%)	77.1	7.7 (41–97)
Δ FEV_1 (mL/yr)	−47.0	6.9 (−570 to 483)
ΔFVC (mL/yr)	−47.0	7.7 (−557 to 476)
Moderate AO at most recent test, by age	n/N (%)	Expected %*
<30	5/127 (3.9)	2.8
30–39	19/329 (5.8)	3.2
40–49	36/416 (8.7)	5.3
50–59	34/276 (12.3)	10.3
≥60	14/76 (18.4)	13.2
Body mass index category, most recent test	N	%
≤25	249	20.3
26–30	567	46.3
31–35	288	23.5
>35	120	9.8
Current smokers†	119†	22.4†

*Expected moderate airflow obstruction (AO) estimated for US population using NHANES III data.[45]

†The number and percentage are based on responses from 544 of the 1224 workers who reported smoking status during the years 2008 and 2009.

longitudinal decline criteria prior to eight years of follow-up (n = 20; 7.4%) or the mean rate of decline from in those with eight or more of follow-up (49; 18.1%).

Most recent spirometry tracings and values from 53 of the 69 workers identified as having excessive decline in FEV_1 were reviewed (16 tracings were not available). Of the 53 tests, 74% met the ATS/ERS 2005 guidelines for FEV_1 and FVC acceptability and repeatability. Of the 14 (26.4%) tests that did not meet the ATS/ERS recommendations for FEV_1 and/or FVC, 2 (3.8%) had quality issues that affected test interpretation and should be excluded from the calculation of longitudinal spirometry changes and 11 (20.8%) had quality issues that could potentially affect longitudinal interpretation (eg, six tests had the highest value deleted by the technician) and require retesting to confirm the excessive decline.

DISCUSSION

The traditional occupational safety and health promotion approach has been mainly focused on prevention of harmful occupational exposures and work-related diseases. A new approach promotes integration of occupational health and safety with worksite health promotion to reduce health- and productivity-related costs.[1,2,4] Published evidence indicates that these approaches are synergistically more effective in protecting and improving worker health and well-being than traditional isolated programs.[5]

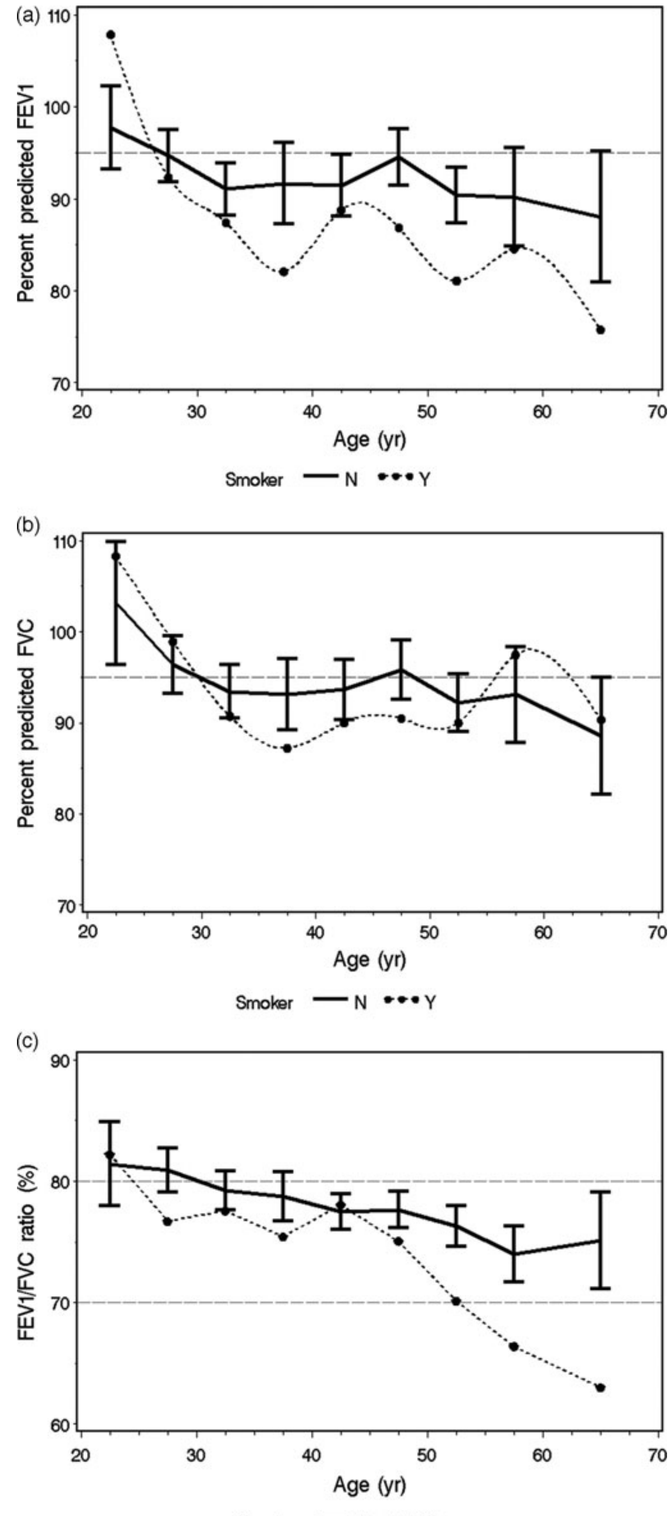

FIGURE 2. The mean percent predicted FEV_1 and FVC, and the observed FEV_1/FVC ratio by smoking categories (N = nonsmoker, solid line with mean 95% CLs, Y = smoker, dotted line with star symbol).

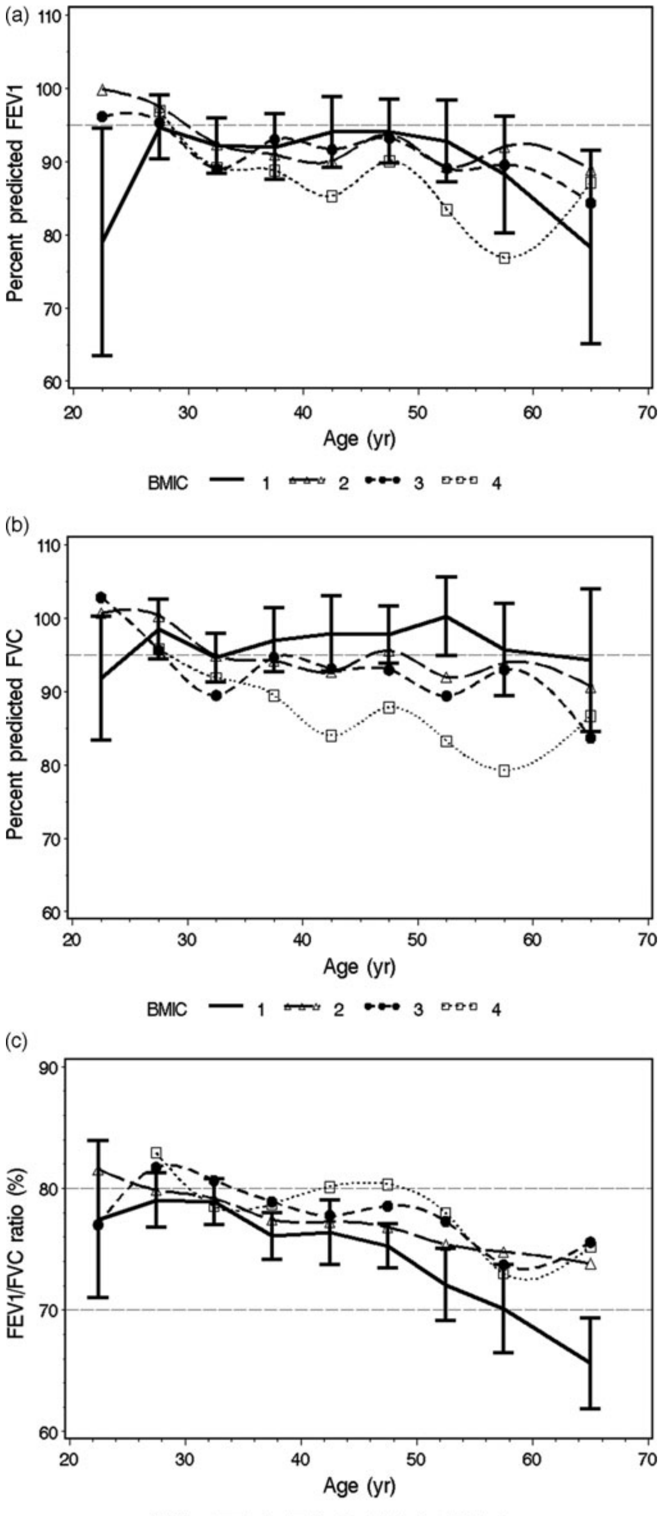

FIGURE 3. The mean percent predicted FEV_1 and FVC, and the observed FEV_1/FVC ratio by age, stratified by BMI categories. (1 = BMI 20–25, solid line with mean 95% CLs; 2 = BMI 26–30, dashed with Δ; 3 = BMI 31–35, dashed with •; 4 = BMI > 35, dotted with □).

This report describes integration of pulmonary function preservation intervention with an ongoing worksite wellness program in workers employed in the US heavy-construction industry. Because health and safety are both long-standing strategic goals themselves at the company, a culture that supports individual health already exists. The participants selected for the pulmonary intervention have for the vast majority been involved in the 9-year-old health behavior change program offered to all employees and spouses. This has made acceptance of both the safety and wellness interventions associated with the respiratory component a nonissue to date.

Most chronic airway respiratory diseases are preventable by eliminating causal environmental risks factors. The construction workers are potentially exposed to silica dust and other kinds of respiratory hazards in various tasks (eg, welding, abrasive blasting, jack and hoe hammering, concrete crushing, rock and concrete drilling, sawing concrete and bricks, and demolition work) and need to maintain their respiratory fitness to wear respiratory protection equipment. Preintervention results indicate that there is a need for respiratory disease prevention program in the studied workers. The mean rate of lung function decline in the workers with 5 or more years of follow-up was 47 mL/year, which is greater than the 20–30 mL/year expected for healthy nonsmokers,[46] and the percentage of workers with moderate AO was higher than that expected in the US male population[45] across all adult age categories (Table 2). Furthermore, evidence shows that susceptible individuals whose FEV_1 declines excessively from younger age are at increased morbidity and mortality risk.[20–22,49,50]

Description of the most recent spirometry tests shows that tobacco smoking was associated with lower FEV_1 values and lower FEV_1/FVC ratio (ie, obstructive lung function pattern) starting from about 25 to 30 years of age (Figs. 2A and 2C). In smokers aged 50 years and older, the mean FEV_1 values were decreased and the mean FEV_1/FVC ratio was 70% and decreased even more with increasing age, indicating that a large number of the older smokers may have COPD. Because smoking cessation is a part of the worksite wellness program, it is possible that the current smokers are the heavier smokers who were not able to quit. Obesity was associated with a restrictive type of impairment (Fig. 3C), especially in those with BMI more than 35. Since abdominal obesity is associated with increased risk of metabolic index–related diseases, which, as hypothesized, can lead also to increased inflammation in the lungs,[51] prevention of abdominal obesity through diet and exercise is important and is part of the intervention plan. Lack of occupational exposure data for individuals did not allow us to evaluate its effect on lung function. In future, the computerized questionnaire data and workplace measurements could be combined for such an evaluation.

Periodic spirometry can be a useful tool for respiratory disease prevention. Computerized approach to longitudinal data management and evaluation helps the health care provider monitor longitudinal data precision and quality across a group and in individuals and helps to interpret the longitudinal changes with better awareness of the existing data quality and also to intervene on spirometry quality.[26,27,41] The results from the spirometry quality and data precision overview[41] provide also useful feedback to the spirometry testing services. In the case of the construction company, based on the spirometry quality evaluation, NIOSH provided retraining to the van services technicians in 2010. Many companies rely on the expertise of the spirometry technicians to conduct spirometry testing in compliance with the ATS/ERS recommendations. To ensure spirometry quality, it is important that the health care provider regularly reviews spirometry tracings for quality and provides feedback to the testing services.

The computerized approach to the evaluation of longitudinal spirometry and questionnaire data enables the physician to screen for a subgroup of at-risk workers (eg, those who show excessive decline in lung function). The longitudinal data evaluation helps to take into account the level of lung function as well as the rate of decline in predicting the risk of future impairment.[24,27,41] Often individuals with "abnormally" low level of lung function follow the normal trajectory for the decline with age. On the contrary, many workers with "normal" level of lung function may have excessive decline reflecting underlying adverse changes in the lungs or disease progression.[24] Both groups of workers thus benefit from longitudinal data evaluation. Spirometry data and respiratory symptoms may not always reflect the same underlying condition in the lungs. For example, individuals reporting chronic bronchitis may suffer mainly with upper airways inflammation and may not demonstrate excessive decline in lung function. On the contrary, many asymptomatic workers can show excessive decline in lung function due to worsening small airways disease or emphysema.[48-50]

Computerized implementation of intervention should allow for systematic application of the intervention strategies including occupational and lifestyle risk factors (Table 1). Longitudinal spirometry charts for those showing excessive decline (Fig. 1) may help to motivate a worker to cease smoking or to work with the employer to reduce exposure to respiratory hazards. Since confidentiality is an important issue in workplace screening, no individual medical data should be provided to the employer by health care providers. A computerized approach facilitates providing group results (eg, Figs. 2 and 3) to the employer for strategic and planning purposes. Since the program is integrated as part of an existing wellness program, the additional cost is mainly with data management and this should be offset by the use of information technology.

In conclusion, this report describes development of a computerized respiratory disease prevention program implemented among heavy-construction workers and integrated into an existing wellness/behavior change program. The baseline results from the existing data indicate the need for more effective utilization of the periodic spirometry and questionnaire data for disease prevention. The computerized program provides an opportunity for future evaluation of the impact of such a program on workers' health and health care costs.

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