Quantitative respirator fit testing and prediction of respirator size in Southern African respirator users

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INTRODUCTION

Workers in various workplaces use respirators to protect themselves from airborne contaminants. As the least preferable means of protection for workers, respirators must be designed and manufactured to perform reliably. Respirator fit testing is a method used for ensuring that a particular size and style of respirator fits the face of the worker and also manufactured to provide maximum protection. Respirators are designed to fit as many people as possible, the designs are based on facial anthropometric (human facial size and shape) data obtained from large groups of people who participated in projects to design respirator fit test panels. Respirator fit test panels provide an objective tool for selecting representative human test subjects based on their facial characteristics for use in research, product development and certification of respirators.

Figure 1: Examples of respirators

OBJECTIVES

The objectives of the study is to (1) improve the protection of Southern African workers using disposable respirators through quantitative respirator fit testing and also to (2) to predict face sizes of Southern African respirator users and to group these faces into three face sizes (small, medium and large) based on the NIOSH fit test panel using two facial dimensions (face width and face length).

METHODOLOGY

Quantitative respirator fit testing was conducted on 652 workers using a PortaCount fit testing machine 8038 model. Workers were tested on current respirator models and sizes supplied with. Four facial dimensions were taken on 562 workers using calipers and a tape measure and plotted against the NIOSH fit test panel. STATA 14 was used to perform descriptive and inferential statistics. The effect of the independent variables including face dimensions, race, smoking, respirator make and size, and age-group was explored using multiple logistic regression stratified by sex.

Figure 2: PortaCount 8038 model

RESULTS

Seventy-two percent of respirator users failed fit testing and were thus not protected by their currently supplied respirators. Eighty-nine percent of the respirators were medium-sized and only 54% of the participants passed. When the measured face length and face width of participants were plotted against the new bivariate NIOSH fit test panel, it was found that 35%, 58% and 7% of the participants had small, medium and large faces respectively. Multiple logistic regression analysis showed that face length (OR 1.04, 95%CI 1.00 – 1.09), nose bridge width (OR 1.16, 95% CI 1.06 – 1.28), and respirator make (OR 0.56, 95% CI 0.39 – 0.78) were both significant predictors of overall fit for all subjects and for women alone.

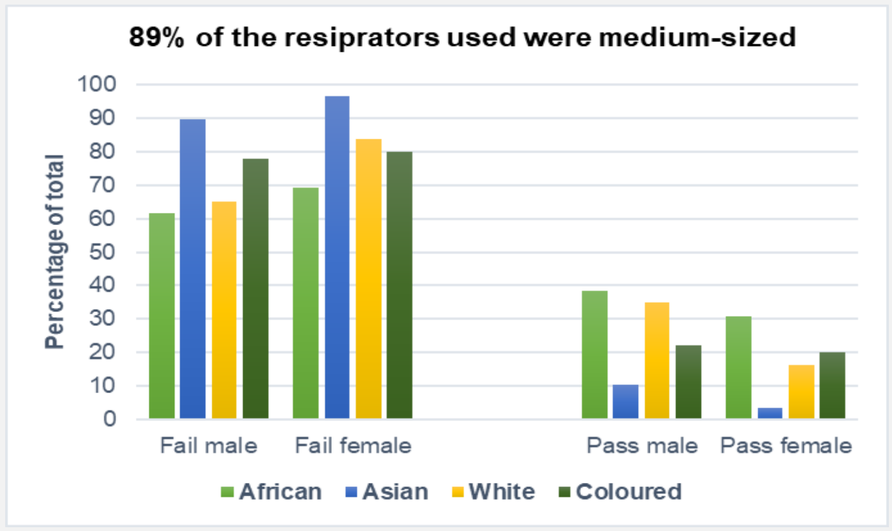

Figure 3: Proportion of fit, pass/fail by sex and race group

DISCUSSION AND CONCLUSION

A large proportion of participants were using poorly fitting respirators. The reliance on medium respirators is likely to be a major problem as it provides a false sense of protection to workers. Fit testing of respirators is therefore an important element of the respiratory protection programme. It should be included in the respiratory protection programme and should be implemented. Asians achieved the lowest proportion at 7% when compared to other race groups and were less protected by the current supplied respirators. Since face-size and nasal root breadth were found to both be significant predictors of overall fit, face-size predictor may be essential to predict the correct size of the respirator to participants prior to fit testing. To ensure that the respirator is effective at reducing risk, it is important to match the people according to their facial characteristics with the correct size and style of the respirator. Future studies may include the investigation of the relevance of panels used in designing and testing respirators which are worn by Southern African workforce.

REFERENCE

Manganyi J, Wilson KS, Rees D. Quantitative respirator fit, face sizes, and determinants of fit in South African Diagnostic Laboratory respirator users. Annals of Work Exposures and Health. 2017;61(9):1154-62.

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