



Anthropometry and hand performance evaluation of minority population

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ABSTRACT

The goal of this research was to evaluate the hand anthropometrics and hand performances of the US minority population. This study had three specific objectives (1) to evaluate the anthropometrics of the US minority population and understand their variability within the general US population (2) to evaluate performance variation of the minority population for different hand conditions and (3) to develop models for a set of performance measures using the anthropometry of the upper extremity. Fifteen subjects from each of Hispanics, African Americans, Asian Indians and Vietnamese population groups participated in this study. Hand length, hand breadth, upper-arm length, forearm length, arm length and hand volume were the anthropometrics recorded. Hand performance dimensions including dexterity, tactility, manipulability, grip strength and a set of functional tasks were measured for bare hand and gloved (cotton, Kevlar, leather and vinyl) hand conditions. Anthropometric evaluations determined a significant effect of ethnicity and gender on hand length, forearm length, arm length and hand volume. Anthropometric comparisons determined that the ethnic groups represented different percentiles within the US population. Performance evaluations determined a significant effect of ethnicity, gender and glove type on the hand performances of the Minority population. The best models were obtained for grip strength as compared to dexterity and manipulability. More validation is required before generalizing the findings of this study.

Relevance to industry: While a number of studies have established differences in anthropometry among different ethnic populations, very few studies have addressed their effect on performance. This study provides fundamental information on the anthropometrics and its effect on hand performance of the minority population in US. The findings of this study will assist engineers to consider personnel variations (anthropometry and performance) to improve productivity. Hence it is very relevant to the industry.

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1. Introduction

United States of America is the third most populous country in the world next to China and India. The 300 million people in the US have been classified into Caucasians, Hispanics, African Americans, Asian Indians, Alaskan and Native Americans, and Hawaii and Pacific Islanders based on their race (US Census Bureau, 2000). People other than the Caucasians are generally termed as “Minorities”, who constitute about thirty percent of the total US population. In the last decade there has been an increase in the immigration of minorities from other parts of the world for economic reasons. The US Census Reports (Ramirez and Patricia de la Cruz, 2003; McKinnon, 2003, and Reeves and Bennett, 2003) have identified that many of the immigrants are employed as

technicians, operators or blue collar workers. The anthropometrics of the immigrants vary in size and shape based on gender, age, and race.

1.1. Anthropometric evaluation

The interracial anthropometric evaluations have compared the hand anthropometry of Asians with their Western counterparts. Imrhan et al. (1993) compared twenty four hand dimensions of Vietnamese American females with the available dimensions of Hong Kong, American, Japanese and United Kingdom females. They identified that Vietnamese Americans hand were shorter, broader and less thick than Hong Kong and United Kingdom females. Pennathur and Dowling (2003) have reported degradation of functional anthropometry with age for Mexican population. Imrhan and Younes (1996) measured, and compared the female hand dimensions of Asian American with American and European females. Their results showed that Asian American women had

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