EVALUATION OF OCCUPATIONAL HEALTH PROBLEMS OF CYCLE RICKSHAW PULLERS AND REDESIGN OF CYCLE RICKSHAW ON ERGONOMIC PRINCIPLES

REDESIGN OF CYCLE RICKSHAW

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The cycle rickshaw is a modified tricycle, which is used extensively as a mode of transport for carrying passengers and luggage. All over India, about 8.5 lakh persons earn their livelihood by pulling cycle rickshaw. The cycle rickshaw pullers undergo heavy physical work during carrying passengers. Besides, the pullers have to work in hot summer and rainy season.

The objectives of the present study was to develop a new design of cycle rickshaw, which would be more comfortable for the driver to pull with lesser effort as well for the passengers to board and travel.

Various dimensions of the existing model were measured. Anthropometric measurement of 957 cycle rickshaw pullers and of Calcutta, Chinsurah, Bhubaneswar, Patna and Lucknow were recorded and percentile values (5^{th}, 50^{th} and 95^{th}) were computed. The energy cost of 106 cycle rickshaw pullers during work was also determined. The values of all the places showed that the workload of the subjects was 'heavy' to 'very heavy'.

The dimension of the new model was decided after studying the anthropometric characteristics of human body and dimensional characteristics of the existing model of cycle rickshaw. A schematic diagram of the new model (M1) was prepared and fabricated in a workshop. After studying the merits and demerits of it, two more models (M2 and M3) were fabricated (Fig 1). The modifications made in the redesigned models have been presented in Table 1. In order to evaluate the efficacy of the three new models along with one new rickshaw (M0) of existing model, the energy cost of pulling these rickshaws were assessed.

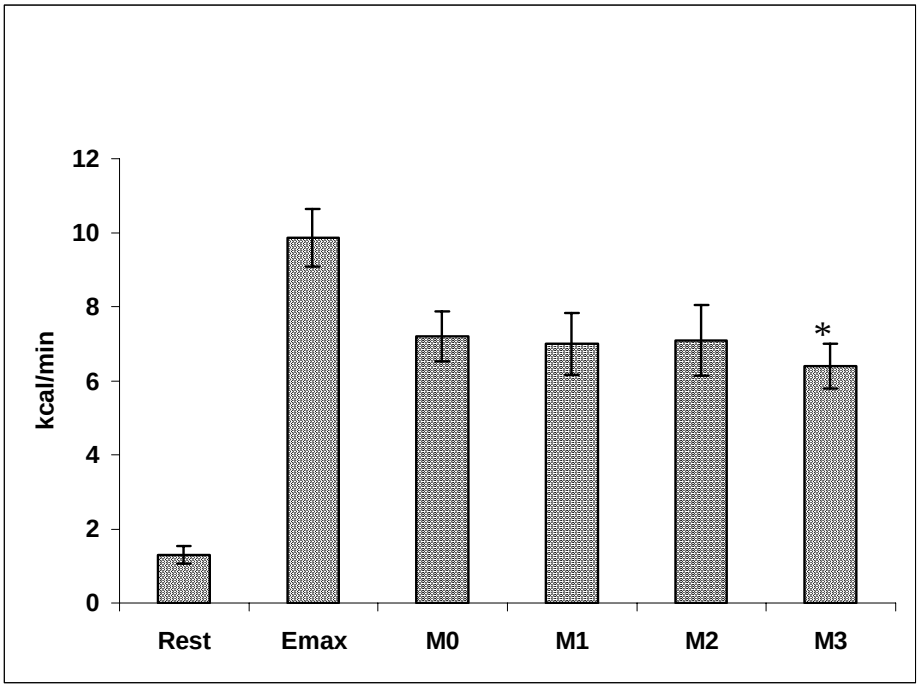
The mean value of energy cost during work were 7.19 ± 0.68 (M0), 6.99 ± 0.83 (M1), 7.09 ± 0.95 (M2) and 6.40 ± 0.59 (M3) kcal/min. The comparison of energy cost of rickshaw pulling with two passengers in four models (Fig. 2) shows that the energy cost of pulling M3 was significantly lower ($p<0.01$) than that of M0. Although there was no significant difference in energy cost in M1 and M2, the modifications in design were made based on the ergonomics principles and facilities like comfortable sitting arrangement, luggage space for passengers and driver's hood have been provided.

In conclusion the Model 3 (M3) may be considered to be a better model in respect of significant decrement in energy cost. Moreover level of comfort and safety of the pullers and passenger was raised.

Table 1 : Modifications in redesigned models

Element	Existing model	Redesigned models
Structure and weight of vehicle	Heavy structure of iron and wood weighing about 120 kg	Weight reduced to 98 kg.
Driving mechanism	Driving force is transmitted to only one of the rear wheels fixed with the axle.	Force is transmitted to both the rear wheels with the help of an additional front axle and three chains. Advantages: 1.Two axles-three chain system makes both the rear wheels free 2.Reduction in effort for keeping the vehicle in a straight path 3.Reduction of the frictional force on the rear wheels4.Independent movement of the rear wheels helps the vehicle to turn easily
Brake system	Brake in front wheel only	Brake in front as well as both the rear wheels. Advantage: More efficient control.
Driver's hood	Absent	Provided Advantage: Protect the driver from sun and rain
Passengers' seat unit	The width and depth of seat for passengers is not sufficient for two persons to sit comfortably. No arm rest Uncomfortable back rest	Sufficient space for passengers without inclination. Arm rest and back rest provided based on anthropometric data Advantage : More comfortable for passengers
Luggage Space	Luggage space inadequate	Space provided for keeping luggage increasing comfort for the passengers.
Boarding height	The footboard is too high and curved.	Height reduced, flat surface. Additional step at lower height provided. Advantage : Easier to board, especially for the ladies, children and old people.

Figure 1. Existing model and redesigned models of cycle rickshaw



* = p<0.01 when compared with existing model (M0)

Fig. 2: Comparison of Energy Cost of cycle rickshaw pulling with existing and redesigned models (Mean ± SD) (n=12)