Sociocultural Influences on the Working Capacity of Elderly Nepali Men

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The influence of sociocultural factors on physical working capacity is often ignored or treated as a residual category of little interest. Most catalogs of the factors influencing physical working capacity consider the sociocultural environment as "noise" to control for when analyzing what are taken to be the "basic", physiological, parameters of interest. It is common, therefore, for exercise physiologists to focus on those factors that can directly generate variation in the cardiorespiratory components of physical working capacity, for example on activity or nutritional status, while ignoring sociocultural parameters. Such factors, however, are rarely distributed uniformly and homogeneously in populations, and this distributional variation is determined to a large extent by sociocultural forces. Consequently, an ecological or population perspective on physical work capacity requires consideration of sociocultural factors.

Measuring sociocultural variables, however, is often problematic. Not only are different variables important in different populations (e.g., caste vs class), but they are often not objectively quantifiable on a universal scale analagous to temperature or hemoglobin concentration. Consequently, determining the relevant sociocultural variables to measure, deciding how to measure them, and then comparing sub-populations or populations, present formidable hurdles to the biological researcher.

A cursory examination of the literature reveals several common ways of dealing with the issue of sociocultural factors, none of which is completely satisfactory. One way has been simply to ignore the possibility of socioculturally generated variation and describe the population under investigation as "peasants", "natives", "residents", etc., i.e. as a category undifferentiated apart from age and sex. This implicitly assumes that variation within such categories is smaller or less interesting than

differences between them and their non-peasant, non-native, etc. counterparts. A second way has been to make rudimentary and often ethnocentric subdivisions such as economic status measured by income. However, it is clear that in some societies other factors, such as caste, may be more important than class, and this is a matter for empirical investigation not *apriori* assumption. Transposing factors that are important in Western societies to non-Western ones implicitly assumes that a given variable has the same influence in all cultures, and this is, of course, false. A third way has been to use well-known "ethnic groups", e.g. Tibetans, Hindus. This implicitly assumes that groups isolated on the basis of a single feature such as geographic origin or religion are homogeneous in other respects. These approaches, therefore, have serious limitations in that they neither pose precisely framed questions that seek to identify the sociocultural factors influencing working capacity nor do they determine how such factors operate or the extent of the effect.

This paper focuses on these issues. It presents a general model depicting the paths by which sociocultural influences affect physical working capacity, and then presents a case study from Nepal.

Figure 1 describes a general model of the way that sociocultural influences may generate variation in physical working capacity. The model depicts the centrality of the cardiorespiratory parameters that are the direct determinants of physical working capacity and through which all other factors must operate. These cardiorespiratory parameters are subject to a number of unmodifiable and modifiable influences. The unmodifiable influences include (a) direct physical macroenvironmental features, for example low pO2 availability at high altitudes, and (b) direct biological characteristics, for example the age-associated maximal heart rate.

The modifiable direct influences are grouped together under the label "intermediate variables". This label emphasizes that these influences are the

link between the sociocultural environment on the one hand and cardiorespiratory factors and physical working capacity on the other hand, and that these are subject to sociocultural forces. The intermediate variables include microenvironmental variables such as workplace temperature and biological variables such as nutritional status, health and activity patterns. In addition to the sociocultural environment, the intermediate variables are subject to the influence of the physical environmental and biological characteristics, for example a particular physical environment may provide the appropriate conditions for disease vectors and biological aging processes may cause changes in health status.

Sociocultural influences must act upon these intermediate parameters in order to generate variation in physical work capacity. The small number of physiological mechanisms contrasts with the large number of possible sociocultural influences. For example, the heart rate (HR) response to exercise is determined in part by the level of habitual activity which is influenced by cultural norms for the appropriate behavior of individuals of different age, sex, and social status as well as by variables such as socioeconomic status, occupation, household demography. Consequently, one might hypothesize that the activity, and hence the physical work capacity, of a wealthy grandfather living in a large multigenerational household would differ from that of a poor young widow living alone. There are many possible combinations of factors. Some subdivisions such as the one just described may appear obvious, others may not: for example, poor grandfathers living in large multigenerational households or rich grandfathers living alone. Whether these differ in activity and physical working capacity would be empirical questions for investigation. The insight gained from attention to sociocultural patterns will enable identification of reasonable subdivisions and the development of appropriate testable hypotheses about where and why

variation in activity and physical working capacity is observed.

This model is illustrated by data derived from a study examining the relationship between activity, health and physical fitness of the elderly in a non-Western setting (see Beall et al, in press 1985; Beall et al ms.) The study population are native residents of the rural agrarian community of Chetbesi (pseudonym), Lamjung District, Nepal. This is a traditional, rural, low altitude (918 m), community with a monsoonal climate that is perched on the steep slopes rising from the Marsyangdi River. It is located in a roadless, rugged mountain terrain without facilities such as electricity, sanitation or machinery. Human and animal muscle power the sources of energy are for transportation and production. Farming and herding are the basis of the local economy, and arable land is the critical economic resource.

Chetbesi is inhabited by several ethnic groups including Nepali-speaking Hindus who are the subject of this study. Nepalese Hindu communities are divided into hereditary, immutable social groups called castes into which individuals are born and remain for their entire lives. The social system segments these castes into a broad two part hierarchy consisting of socially pure high castes (Brahmins and Chetris) and socially impure, low or untouchable castes (Kami - blacksmiths, Damai - tailors and Sarki - leatherworkers). Associated with these notions of social purity and pollution are sets of restrictions on behavior including occupation. For example, a person born into the low blacksmith caste cannot adopt tailoring as his occupation nor could a tailor adopt smithing. A person born into the high Brahmin caste cannot plow fields. All castes may perform most agricultural tasks, apart from plowing. Thus, birth into one of these hereditary social categories greatly dictates the preferred, permitted, and prohibited activities throughout an individual's lifetime.

The Hindu social hierarchy tends to be associated with the economic hierarchy. In these communities the members of the two high castes own good agricultural land and are predominantly middle income or well-to-do in village terms. The low castes also own or lease land, usually small plots of poor quality whose yields suffice for only a few months' food supply. Therefore they are forced to rely on providing services and earn their livelihood largely as craftsmen and manual laborers. They are typically low income, albeit not impoverished or destitute. A few households, in fact, are middle income.

All the native high and low caste Hindu males aged 60+ living in three wards of Chetbesi were identified by a census survey and invited to participate in a study of the health of the elderly. Forty-three (88%) of the eligible people participated in the study including 9 Brahmins, 16 Chetris, 6 Damais, 3 Kamis and 9 Sarkis (mean age 67 $\pm$ 7, range 60-88). The physical working capacity of 34 individuals was measured by a cycle ergometer test using an intermittent multistage protocol. Nine men (21%) were excluded from performing the test on medical grounds or by pain or weakness which obviated pedalling. One Sarki failed to give a good effort on the test and was eliminated from analysis. Thus the analysis of physiological data is based on a sample of 33 men with a mean age of 66 $\pm$ 5, range 60 - 77. Measurements of heart rate and systolic blood pressure were made in the course of the cycle ergometer test. Measurements obtained during the third minute of exercise at the 150, 300 and 450 kpm submaximal workloads are reported here.

A logical initial subdivision for analysis is one comparing high and low caste as this roughly coincides with a culturally important distinction and with socioeconomic status. Figure 2 demonstrates that there is significant physiological variation in response to cycle ergometer exercise; low caste men have lower HR at 300 and 450 kpm effort. Figure 2 demonstrates also that the

coarse subdivision into high and low caste is misleading and confounded. A single low caste, the Sarkis, accounts for the contrast.

The Sarkis differ systematically in cardiorespiratory characteristics measured before, during and after exercise. They have lower resting HR, lower HR at 150, 300 and 450 kpm submaximal workloads and lower HR after terminating exercise (see Beall et al, in press 1985 for details). This indicates a more efficient, well-trained physiological adaptation to exercise stress. The close correspondence of the lines depicting the high caste and those depicting all the low caste non-Sarkis emphasizes the physiological similarity of the Damais, Kamis, Brahmins and Chetris and highlights the contrast between these four groups and the Sarkis. The non-Sarkis and Sarkis do not differ in HR and systolic blood pressure at peak tolerated work effort.

The model in Figure 1 suggests a systematic approach to developing an explanation for this intracultural variation in physical work capacity. The macroenvironment, assessed by temperature, humidity and altitude, in which the Sarkis and non-Sarkis live and work does not differ as they are part of a single residential community. The unmodifiable biological characteristics of Sarkis and non-Sarkis do not differ as they are all native males of the same average age and age range. Turning to the intermediate socioculturally modifiable variables, since most activities are conducted out of doors and therefore, the microenvironments do not differ. The health statuses do not differ as both groups were subject to the same health screening to determine eligibility for participating in the cycle ergometer test. Other assessments of health status such as measurements of pulmonary function by FVC and FEV 1.0 provide further evidence of similarity (refer to Table 1). Nor does the nutritional status of Sarkis differ from that of non-Sarkis. Anthropometric assessments of nutritional status including body mass index, and the percent

of body fat estimated from fatfolds do not differ (refer to Table 1).

The similarity of the macroenvironment, of the unmodifiable biological characteristics, of the microenvironment, and of the health and nutritional status of the Sarkis and the non-Sarkis suggests that the fitness difference is most likely the outcome of differences in habitual activity patterns. Performance of heavy tasks causing HR elevation is probably the source of training effects influencing physical working capacity.

For complex social and historical reasons, the Sarki caste in this area has formed the agricultural labor force for the high castes while the Kami and Damai castes have subsisted mainly by practicing their less strenuous traditional crafts of smithing and tailoring. The Sarkis perform heavy work for the Brahmins and Chetris, particularly agricultural labor. They also work as porters, masons and construction workers. Consequently, the Sarkis' subsistence mode is distinct from both the high castes and the other low castes in that it entails performing hard labor throughout the year.

Furthermore, Sarkis are likely to continue to perform heavy manual labor throughout their lives. Eight of the nine Sarkis in this sample of men 60-77 years old perform manual labor for others: plowing/levelling fields, stone cutting, masonry, construction and portering. The sole exception is a 77 year old who had discontinued plowing with the current season. In contrast, just three of the nine other low caste elderly men hire out occasionally as laborers in addition to plying their traditional trades which entail moderate and low activity. The Brahmins and Chetris do not supplement their agricultural incomes with manual labor for others although they may perform heavy tasks for themselves.

Direct observation of the daily activities of Sarkis and non-Sarkis confirm these self-reports. While the Sarkis performed heavy labor such as plowing or load carrying on half (5/10) of the days of direct observation,

non-Sarkis performed heavy labor on just one quarter (22/87) of the days of observation. Moreover, when undertaking heavy tasks such as plowing, the Sarkis work at them for long periods: a median of 58% of the observed day (12-13 hours of observation) compared with 16% for non-Sarkis. Heavy tasks occupied 47-66% of the day on 4 of the 5 days when Sarkis engaged in such tasks whereas they occupied an equivalently large proportion on just 5 of the 22 days when non-Sarkis engaged in them. Both the frequency and the duration of heavy work differ between Sarkis and non-Sarkis in a way that could produce the measured differences in physical working capacity. Walking in the rugged terrain has a component of heavy activity, but Sarkis and non-Sarkis walk outside their house compounds for equivalent amounts of time. The Sarkis spend a smaller proportion of the day engaged in light activity. This is additional evidence that occupational activity requirements are the source of differences in fitness. Overall, Sarkis spend more time engaged in heavy labor, the same amount of time walking and less time at light tasks.

Daylong HR monitoring confirms that Sarkis' daily workload is generally heavier. The daylong average HR of Sarkis (78 $\pm$ 16, n=5) and non-Sarkis (83 $\pm$ 11, n=28) do not differ. This similarity is evidence that the more fit Sarkis do more work. Because of their greater fitness and their lower resting HR, a heavier workload is required to elevate Sarkis' HR to the same level. If the workloads were the same, the well-trained Sarkis would have lower HR.

This is illustrated in Figure 3 by cumulative frequency curves of daylong HR for a 60 year old Sarki (A) and a 70 year old non-Sarki (B) performing the same activities. The Sarki spent 81% of the day engaged in light activity and 19% walking and the non-Sarki spent 80% and 20%, respectively. The Sarki's curve lies to the left of the non-Sarki's and illustrates his performance of the same type of activity at a lower HR. The Sarki's daylong average HR is 41%

of his age predicted maximum HR while the non-Sarki's daylong average HR is 53% of his age predicted maximum HR. The cross on each curve denotes the HR that is 50% of the age predicted maximum HR. The cross is much lower on the non-Sarki curve indicating a larger proportion of HR above this value. Thus the non-Sarki's workload is more intense relative to his age predicted maximum although the two were performing similar activities.

The curve marked C in Figure 3 demonstrates that plowing and levelling fields, a task often performed by Sarkis, constitutes a very high relative workload. The cumulative HR frequency curve for this 70 year old Sarki who spent 66% of the observed day intermittently plowing and levelling fields lies far to the right of the other two curves. Moreover, most of the day's activities occurred above 50% of the age predicted maximum HR. His daylong average HR is 71% of his age predicted maximum HR. The HR data are additional evidence that specific tasks most frequently performed by Sarkis are a great physiologic strain.

This example illustrates the power of sociocultural variables to generate variation in physical working capacity in old age. This variation is accounted for by variation in occupational activity levels. In turn, occupation is a function of birth into a socially defined group, a caste. The Sarkis maintain a physical activity pattern of frequent and long periods of strenuous manual labor, even in old age, and have a greater physical work capacity in old age. The magnitude of the effect is substantial. For example, in this population, the regression of submaximal HR on age reveals HR differences of 7 f/minute / decade at 150 kpm. Working at 150 kpm, Sarkis HR are 13 f/minute lower than non-Sarkis of the same age, roughly equivalent to a two decade age difference.

So far this example illustrates the intricacies of accurate identification and definition of important subgroups for epidemiological

analyses. There is a further level of analysis to consider: why do Sarkis maintain high occupational activity levels as they grow old? After all, a widely commented upon aspect of Hindu culture is that elderly parents should depend upon their sons for security in old age. Since, all but two of the sample (both non-Sarkis) are living with sons, it appears that the opportunity for "retirement" exists. That Sarkis and others do not retire, and that Sarkis maintain high levels of activity is explicable by understanding the sociccultural dynamics of households.

The reasons underlying this activity difference relate ultimately to access to and control over arable land, the basic economic resource in this rural area. Land is held in the father's name and actually controlled by him until his death. The culturally ideal role for an elderly male in Nepalese Hindu society is that of head of an extended household which includes his spouse, married sons and their families, and unmarried children. All household members are under the authority of the household head and are expected to participate in the household economy either by working the family land under his direction or by contributing wages to him. High caste males expect to give up most physically arduous tasks as they grow old but they expect to retain managerial control over their agricultural land and their household economies. By relinquishing the physically onerous tasks to their sons, they become dependent upon them to perform these tasks, but, it is a dependence similar to that of a master on a servant. In this case the son is willing to do the work because of the land he will inherit eventually and use to establish his own independent household.

Low caste males face a different set of circumstances as they age. They are generally without a large estate of arable land and they expect to work for wages. The wealth of the family is the sum of the collective efforts of

sociocultural system generates a unique pattern of variation in physical working capacity that is uniquely explicable, or whether the more desirable scientific goal of the development of general models of relationships is possible. The Chetbesi data suggest the latter. For example, it could be hypothesized that traditional peasant societies with hierarchical and stratified social structures generally contain one or more subgroups which perform the bulk of the hard work and have a high physical working capacity. In this particular case, a highly stratified peasant society, the hard working group comprises the full adult age range of one stratum- the untouchable Sarkis. In a nonstratified society, however, it could be hypothesized that the pattern is either a) completely different in that the hard working group includes virtually everyone in a narrow age range, or b) That it is similar in tat a non-hereditary landless (or poor), segment of the population comprises the hard working group. We suggest that there may in fact be only just a few sociocultural patterns of allocating hard work and therefore only a few general patterns of intracultural variation in working capacity.

Although sociocultural factors are more often than not either ignored or treated cursorily, this study suggests that they play a central role in understanding the distribution of physical work capacity in human populations. Because they affect the distribution of the intermediate variables that affect the key cardiorespiratory parameters, sociocultural factors are essential for explicating how and why differences in physical work capacity exist within a population. However, as indicated in this study, in a culturally alien setting it may be difficult to ascertain what sociocultural factors are pertinent and how they may be held constant. In such unfamiliar contexts, familiar cues may not be present or, if present, may not be applicable. For this reason, it is important to include a serious sociocultural component when investigating

variation in physical work capacity, whether the goal is to obtain explanations at the level of human physiology or at the level of human population differences.

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TABLE ONE

Comparison of Selected Health and Nutritional Characteristics of Chetbesi Sarkis and Non-Sarkis aged 60-77

	Sarkis			Non-Sarkis		
	$\bar{X}$	S.D.	N	$\bar{X}$	S.D.	N
HEALTH STATUS						
FVC (dl BTPS)	261	59	6	268	79	23
FEV-1 (dl BTPS)	187	42	6	186	63	23
NUTRITIONAL STATUS						
EMI (kg/cm^2)	18.4	1.1	8	17.6	2.1	25
% Body fat[a]	14.4	4.1	8	13.8	6.0	25

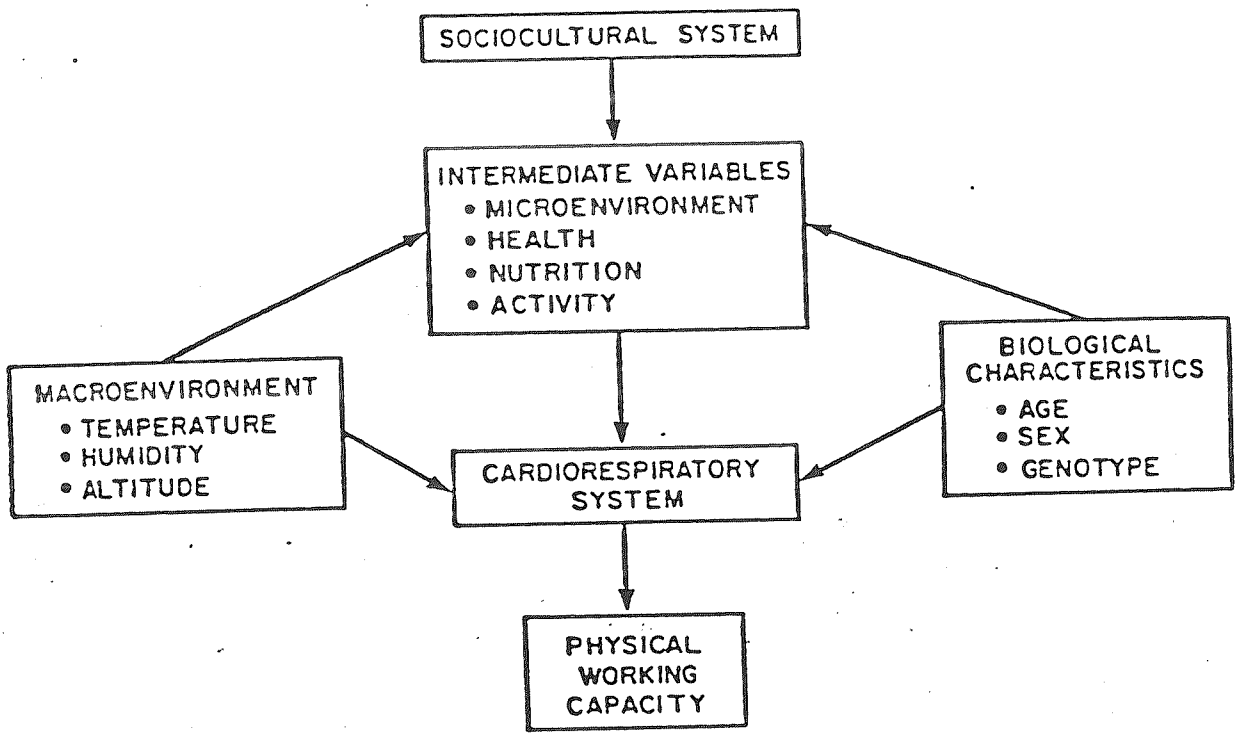
[a] calculated after Durnin and Wormersley, 1974, Table 5 equation triceps, subscapular and suprailiac skinfolds, males age 50 +

FIGURE LEGENDS

Figure 1. A general model of influences on physical working capacity emphasizing the way that sociocultural factors may generate variation by acting through a set of intermediate variables.

Figure 2. Heart Rate (HR) response to three levels of physical work performed by elderly Nepali men: comparison of high vs. low caste and of Non-Sarkis vs. Sarkis.

Figure 3. Cumulative frequency distribution of daylong HR of three Nepali men. A = 60 year old Sarki, B = 70 year old non-Sarki, C = 70 year old Sarki. The x on each curve denotes 50% of the age predicted maximal heart rate.



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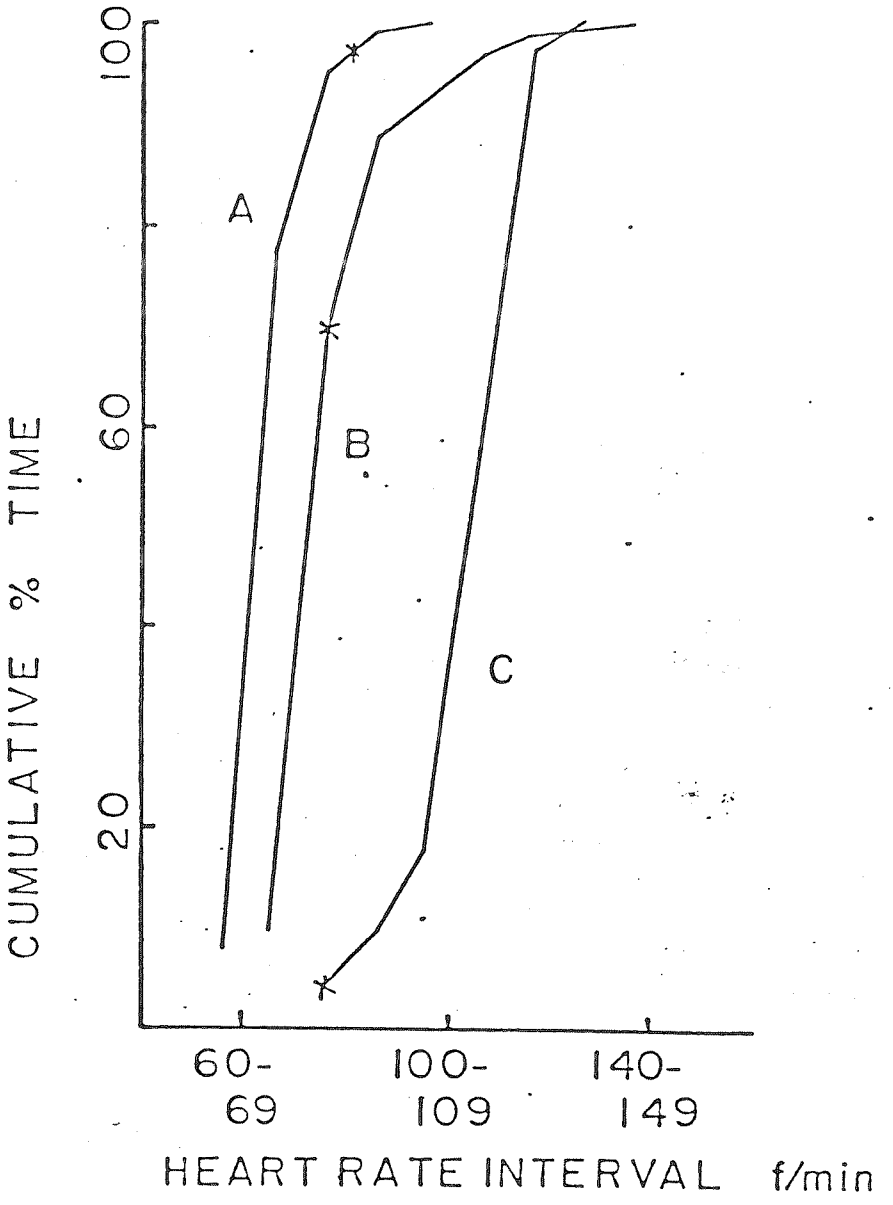

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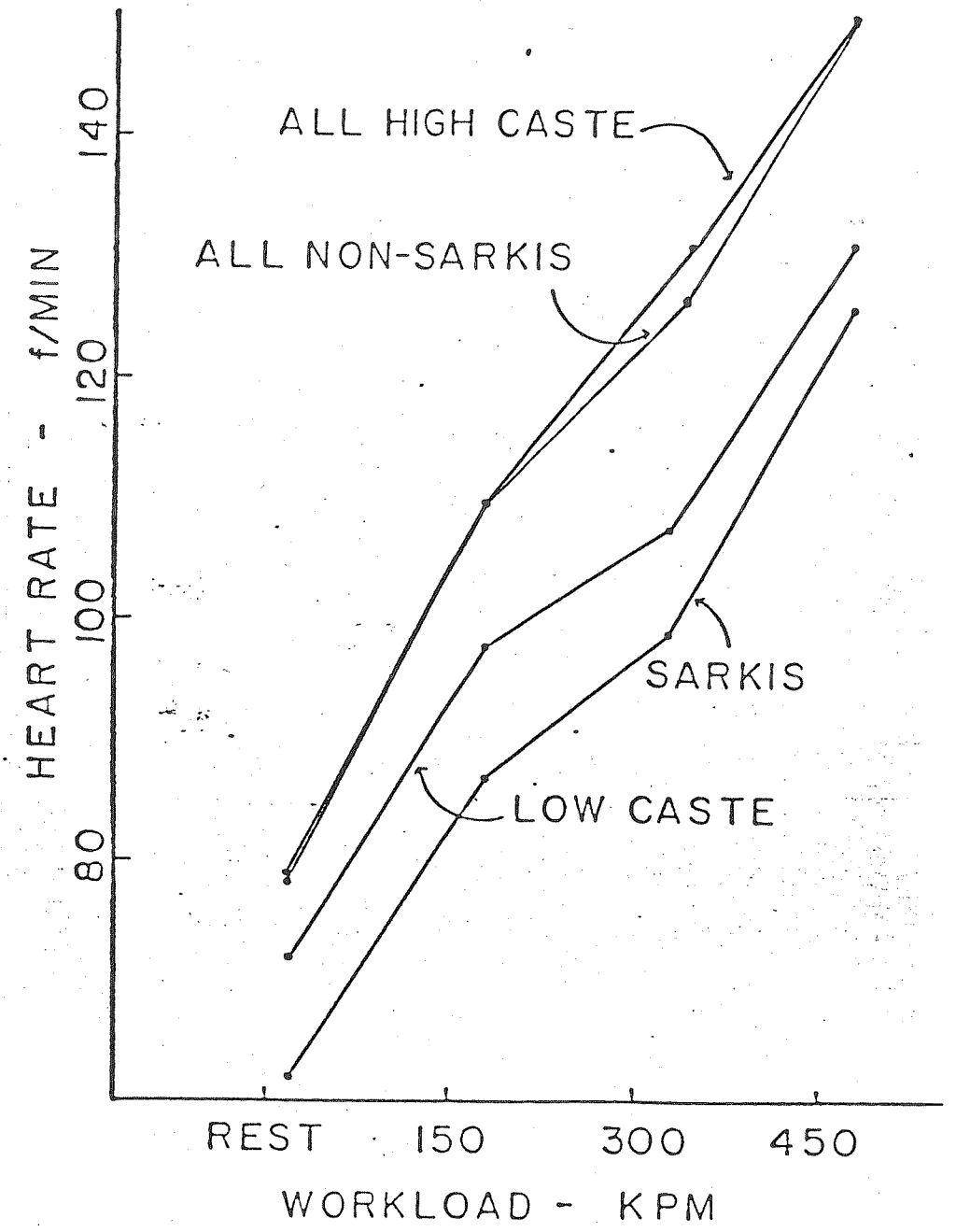

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