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Development of norms for testing breath holding capacity of collegiate students of average health in Pune city

Sajal Maji

Abstract
The purpose of the study was, "Development of Norms for Testing Breath Holding Capacity of Collegiate Students of Average Health in Pune City". The Researcher selected the Chandrasekhar Agashe College, Bharati Vidyapeeth College of physical education, S. P. Pune University Department of physical education for research purpose. 300 male collegiate students are selected for the data collection as per simple random sampling technique. After that researcher collects the data, from those collegiate students with the help of After Inhalation and After Exhalation.
After, the data collection the researcher analysis the data with the help of descriptive statistics (percentile norms and t-test). To development of norms of collegiate students.

Keywords: After inhalation breathe holding, after exhalation breath holding capacity, collegiate students

Introduction
Norms are cultural products (including values, customs, and traditions) which represents individuals' basic knowledge of what others do and what others think that they should do (Cialdini, 2003) [1] Sociologists describe norms as informal understandings that govern individuals' behavior in society. On the other hand, social psychology has adopted a more general definition, recognizing smaller group units, such as a team or an office, may also endorse norms separate or in addition to cultural or societal expectations. In other words, norms are regarded to exist as collective representations of acceptable group conduct as well as individual perceptions of particular group conduct (Lapinski, 2005) [2].
Norms running counter to the behaviors of the overarching society or culture may be transmitted and maintained within small subgroups of society. For example, noted that certain groups (e.g., cheerleading squads, dance troupes, sports teams, and sororities) have a rate of bulimia, a publicly recognized life-threatening disease that is much higher than society as a whole. Social norms have a way of maintaining order and organizing groups.
Although not considered to be formal laws within society, norms still work to promote a great deal of social control. Social norms can be enforced formally (e.g., through sanctions) or informally (e.g., through body language and non-verbal communication cues.) Because individuals often derive physical or psychological resources from group membership, groups are said to control discretionary stimuli; groups can withhold or give out more resources in response to members' adherence to group norms, effectively controlling member behavior through rewards and operant conditioning (Hackman, 1992) [3]. Social psychology research has found the more an individual values group-controlled resources or the more an individual sees group membership as central to his definition of self, the more likely he is to conform. Social norms also allow an individual to assess what behaviors the group deems important to its existence or survival, since they represent a codification of belief; groups generally do not

[1] R. D. Cialdini, "Crafting normative messages to protect the environment". (Current Directions in Psychological Science), 2003, pp.105–109.
[2] M. K Lapinski, and R. N Rimal, "An explication of social norms". (Communication Theory), 2005, pp.127–147.
[3] J. R. Hackman, "Group influences on individuals in organizations." (Handbook of industrial and organizational psychology, Palo Alto: Consulting Psychologists Press), 1992, pp.234-245.

punish members or create norms over actions which they care little about (Feldman, 1999) [4]. Norms in every culture create conformity that allows for people to become socialized to the culture in which they live.

Life is absolutely dependent upon the act of breathing. Breathing is considered the most important of all the functions of the body as all other functions depend upon it. Breath-holding time (BHT) may be considered as one of indicators of efficiency of breathing function. BHT is defined as the time taken by the subject to hold his breath as long as he can. Normal voluntary breath-holding time is 45-55 seconds. Respiration can be voluntarily inhibited for some time, but eventually, the voluntary control is overridden. During voluntary breath-holding, tissues continue to use oxygen and produce carbon dioxide. Therefore, during breath-holding, arterial PO_2 falls and PCO_2 rises, resulting in a state of asphyxia. Since both these factors are powerful respiratory stimulants, a point is reached where the respiratory drive becomes so strong that the person cannot hold the breath any longer. The point at which breathing can no longer be voluntarily inhibited is called the breaking point. Thus, BHT is the time duration from the time of inhibition of breathing till the breaking point (Bijlani, 2004) [5]. The maximal breath-holding time (BHT) has been used in respiratory physiology as a measure of ventilator response (Nunn, 1997) [6]. (Godfrey, 1969) [7] (Godfrey, 1968) [8]. The unpleasant bursting sensation in the lower chest and abdomen and the onset of irregular inspiratory muscle activity have been well documented at the breakpoint of the breath-holding manoeuvre (Fowler, 1954) [9].

Respiratory efficiency can be increased by training. Respiratory efficiency tests facilitate the increase in the strength of the respiratory muscles. Age and sex also affect the breath-holding time (Kesavachandran, 2001) [10].

The properties of breath-holding in humans and its possible cause the breath at breakpoint. The simplest objective measure of breath-holding is its duration, but even this is highly variable. Breath-holding is a voluntary act, but normal subjects appear unable to breath-hold to unconsciousness. A powerful involuntary mechanism normally overrides voluntary breath-holding and causes the breath that defines the breakpoint. The occurrence of the breakpoint breath does not appear to be caused solely by a mechanism involving lung or chest shrinkage, partial pressures of blood gases or the carotid arterial chemoreceptor. This is despite the well-known properties of breath-hold duration being prolonged by large lung inflations, hyperoxia and hypocapnia and being shortened by the converse manoeuvres and by increased metabolic rate.

Breath-holding has, however, two much less well-known but important properties. First, the central respiratory rhythm appears to continue throughout breath-holding. Humans cannot therefore stop their central respiratory rhythm voluntarily. Instead, they merely suppress expression of their central respiratory rhythm and voluntarily 'hold' the chest at a chosen volume, possibly assisted by some tonic diaphragm activity. Second, breath-hold duration is prolonged by bilateral paralysis of the phrenic or vagus nerves. Possibly the contribution to the breakpoint from stimulation of diaphragm muscle chemoreceptors is greater than has previously been considered. At present there is no simple explanation for the breakpoint that encompasses all these properties (Parkes, 2006) [11].

Reviews of related literature

The investigator studied a lot of reviews on research from different related literature available so far in the Libraries and webs. Although the literature on breath holding capacity is very limited, the researcher collected some of the research abstracts that have been summarized below.

Singh *et al*., (2014) [12] assessed the effects of selected Pranayams on Breath-Holding Capacity, Cardio-Vascular Endurance &Reaction Time of high school students in Punjab. Two hundred boy's age group of 13 to 16 years from Govt High School, Kerala, Punjab and S.B.W.S.M.P. School, Banur, Punjab were selected as the research subjects. The Pranayams Training duration was of 10-weeks. The subjects were divided into two groups as experimental (Group A) and control (Group B). The experimental group underwent Pranayams Training for 10-weeks and control group did not receive the Pranayams Training. The 't' test was used to compare pre and post-training values.After10-weeks Pranayams Training there was a significant (P<0.001) difference between pre and post-testing of experimental group for the breath-holding capacity (pre=35.89±1.55, post= 36.92±1.57), cardio-vascular endurance (pre=1710. 27±50.73, post 1785.51±78.24) and reaction time (pre=24.81±0.40, post 23.55±0.43) as well as control group for the breath-holding capacity (pre= 34.28±1.01, post= 34.27±1.02), cardio-vascular endurance (pre= 1580.94±13.62, post= 1498.17±62.78) and reaction time (pre=25.90±0.50, post=25.83±0.52). The experimental group had a significant improvement on Breath-Holding Capacity, Cardio-Vascular Endurance & Reaction Time than the control group.

Rai (2014) [13]. determined the effect of 8 weeks yoga practices (Pranayama) on Breath holding capacity of school going children of Mahilpur. Methods - The method of this study was experimental research and sample were 30 students of senior secondary school of Mahilpur (12-15 Aged). Thirty subjects were randomized into two groups experimental group accomplished yoga practice (Pranayama) for eight weeks. Statistical Technique - Paired sample't' test was used to analyse the data of the study in use of SPSS software. Result-it showed that eight weeks pranayama significantly increased the breath holding time of school children. Recommendation-it is also recommended other parameters of respiratory system need to investigate for further information of Mahilpur.

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[13] Rai Vaibhav "Effect of Pranayama on Breath Holding Time of School Going Children of Mahilpur" journal of educational and practice, 5, 26, 2014, pp. 13-18.

Singh (1986) [14] prepared physical fitness norms for high and higher secondary school boys of Jammu and Kashmir State. Data was collected on 4200 male students belongs to six to eleventh classes of age 13 to 19 years subjects randomly selected and they were administered the AAHPER Youth Fitness Test. Age wise norms were prepared in terms of Percentile scale, Hull Scale and T- Scale. (1991) conducted a study on computation of norms for 12 minute run and walk among school boys. Data was collected on 1000 school boys belongs to sixth to tenth classes of age 13 to 15 years subjects were randomly selected and they were administered the Cooper's 12 minutes Run/Walk test. Age wise norms were prepared in terms of Hull scale.

Box (1973) [15] conducted percentile norm tables for selected measures of strength, power, agility, flexibility, body composition, cardiovascular and muscular endurance from data which is collected in five schools of the Unity Christian School System of
Hudsonville.

Coutts (1971) [16] conducted a study to establish norms for the cooper's 12-minute run/walk test applicable to young males; eighty boys, eleven to fourteen years of age, served as the subjects. The difference between the two groups was statistically significant (P.01). The correlation coefficient between aerobic capacity and run/walk performance was 0.65, while the correlation was statistically significant (P.01); caution was advised in attempting to predict aerobic capacity from run/walk performance with young urban subjects.

Tiwari (2003) [17] developed anthropometric norms for school children age ranging from 9-10 years. Total 200 male students were randomly selected from deferent schools of South Delhi. The anthropometric measurements were: weight, height, Sitting-height, skin fold measurement (biceps, triceps, suprailiac and sub scapula) were tested t-scale, 6-sigma, 7sigma, (hull scale) norms were prepared.

Kumar (2003) [18] developed the norms for two hand-eye co-ordinance. The study was conducted to test the reliability of two hand co-ordinance, to observe the effect of number of trails, to test the repeated reliability and to develop the norms for age and sex of physical education students of university of Delhi. The total of 200 (100 male and 100 female) subjects was randomly selected. The subjects were tested in different climatic conditions for four times.

Methodology

The purpose of this study is to construct the breath holding capacity norms for college level students in Pune city. Standard procedure has been followed to conduct the study. The methodology in details is given below.

Selection of the subject

Out of 400 a total of 300 male collegiate students with the mean age of 22 (± 2.15) years were selected as sample for this study. The simple random sampling technique has been used for making the sample for this study. Three colleges have been selected purposively from Pune city to have the true representation of the population. The colleges which have been selected with the number of students were given below:

Variables

Due to paucity of time period and limitations on other feasibility, the researcher has selected two types of breath holding capacity as variables for the study as follows:

Breath holding Capacity -

- After inhalation, and
- After exhalation.

Tools used

Once the variable has been decided, the researcher has gone through the available literature in the library, reports of previous research studies and webs. Further, after a heavy brainstorming session with the research guide, following test has been chosen, which is easy to conduct in the field situation and requires minimum assistants and less time.

Variables	Tests	Unit
Breath Holding Capacity	Manually conducted with a simple stop watch	Maximum time for holding the breath (Secs.)

Data collection

The students were asked to sit in padmasana or in any comfortable sitting position. The stop-watch is kept ready. The subjects were then asked to inhale deeply and hold their breath by closing two norstrils and mouth till they can do. The time of holding the breath is measured by the stop watch in Secs. They were given 5 minutes rest till their pulse rate reaches the normal resting level. They were then asked to repeat the same trial once again. Out of these two trials, the highest breath-holding time (after inhalation) was the final score (secs.). Further, two similar trials were given to the students to record their breath-holding time (after exhalation) in secs. Now both the scores (i.e., breath-holding after inhalation and after inhalation) were preserved for data analysis.

Statistical Design

For establishing the norms on breath holding capacity immediately after inhalation and after exhalation the proper statistical technique (i.e., percentile norms) was employed. However, to compare the breath holding capacity after inhalation and exhalation, t-test was further employed.

Analysis of data

The data on selected breath holding variables collected from 300 male collegiate students of physical education in Pune city has been analyzed statistically and the results have been presented in this chapter in the form of tables and graphs.

Data analysis

This chapter deals with the results of descriptive statistical analysis of the data on the breath holding capacity variable i.e. 1) after inhalation and 2) after exhalation.

The mean and SD of data on breath holding capacity were calculated (Table 1) and then established the separate norms exclusively for – 1) breath holding capacity after inhalation and 2) breath holding capacity after inhalation (Table 2).

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Findings on norms

The result presented in revealed that –

- Mean and SD values of breath holding capacity after inhalation of the data on 300 males were 48.57 and 16.18 respectively.
- Mean and SD values of breath holding capacity after exhalation of the data on 300 males were 40.06 and 15.30 respectively.

Table 1: Descriptive statistics on breath holding capacity (n = 300)

Sl. No.	Variables	Mean	SD
1	After Inhalation (breath holding)	48.57	16.18
2	After Exhalation (breath holding)	40.065	15.305

The results on percentile norms have been presented in the results indicates that.

- In case of breath holding (after inhalation), the raw score of P_{10} and P_{99} were 28.70 Secs and 92.47 Secs respectively, whereas the score of P_{50} was 46.81 Secs.
- In case of breath holding (after exhalation), the raw score of P_{10} and P_{99} were 23.27 Secs and 92.11 Secs respectively, whereas the score of P_{50} was 37.08 Secs.

Table 2: Percentile grading of breathe holding capacity after inhalation

Raw Score	Percentile	Grading
71.59 – 92.47	P91 – P99	Excellent
60.89 – 69.56	P76 – P90	Good
36.08 – 60.43	P26 – P75	Average
29 – 35.56	P11 – P25	Fair
<28.7	Below P10	Poor

Showed that the percentile grading <28.7 is poor, 29-35.56 is fair, 36.08-60.43 is average, 60.89-69.56 is good, and 71.59-92.47 is excellent.

Table 3: Percentile grading of breathe holding capacity after exhalation

Raw Score	Percentile	Grading
62.74 – 92.11	P91 – P99	Excellent
47.92 – 60.26	P76 – P90	Good
29.69 – 47.55	P26 – P75	Average
23.72 – 29.57	P11 – P25	Fair
<23.27	Below P10	Poor

Similarly, Table indicates that percentile grading <23.27 is poor, 23.72-29.57 is fair, 29.69-47.55 is average, 47.92-60.26 is good, and 62.74-92.11 is excellent.

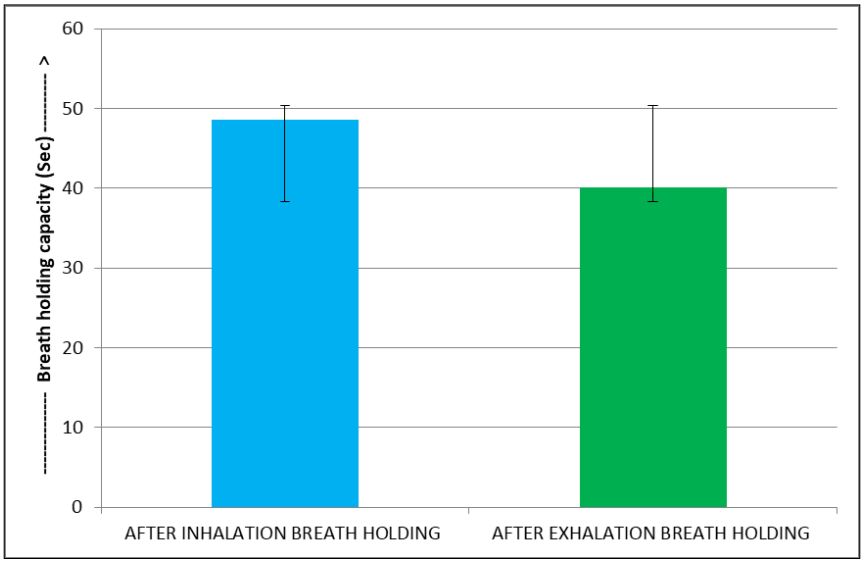
Findings on Breathe holding time (after inhalation Vs after exhalation)

The result of normative study, as presented above, infers that the norms of breathe holding capacity (after inhalation and after exhalation) are applicable and gradable. However, the raw score of 50th percentile (i.e., P_{50}) of breathe holding capacity after inhalation was 46.81 (secs) and after exhalation was 37.08. This indicates that the mean values viz., 46.81 (after inhalation) and 37.08 (after inhalation) are different. Therefore, the significant difference, if any, was determined by using 't' test and the level of significance was set at 0.05 level.

Table 4: Comparison on breath holding capacity after inhalation Vs after exhalation (n = 300)

Sl. No.	Variables	P_{50} values (Mean)	MD	SEM	t-value
1	After Inhalation	48.57	8.505	0.91	-6.6
2	After Exhalation	40.065			
*p<0.05, **p<0.01					

The result of 't' test revealed that mean values of Breathe holding capacity after inhalation and after exhalation were different (t= -6.6, p<0.05). This result indicates that breathe holding time after inhalation was greater than the breath holding time after exhalation.



Mean percentile values after inhalation and after exhalation (Breath Holding capacity)

Discussion of Findings

By keeping in mind the importance of the test taken for the breath holding capacity, the researcher has conducted this piece of research. There were 300 male students from different Physical Education institutes of Pune city. Breath holding capacity has been measured by using a stop watch and the time was recorded in Secs.

In fact, breathe holding capacity determines the better functioning of the respiratory system in human. There are two ways by which breathe holding capacity can be measured – 1) after inhalation and 2) after exhalation.

The result of the present investigation revealed that percentile norms of breath holding capacity (either after inhalation or after exhalation) are applicable to predict the respiratory function ability of the collegiate youths.

Further, the comparative result indicates that generally, the breathe holding time after inhalation was found greater than the breathe holding time after exhalation. As per traditional yoga, breathe holding capacity after inhalation is called antar kumbhaka and breathe holding capacity after exhalation is called bahya kumbhaka. Although both these kumbhakas are useful in pranayama, the most important factor is maintenance time of each kumbhaka. The result of the present study infers that the maintenance time of breath holding after inhalation was better than the maintenance time of breath holding after exhalation. The norms as obtained in this investigation would benefit the aspirants who intend to evaluate his/ her functional ability of respiratory system.

Discussion of Hypothesis

The result of normative study indicates that the norms of breath holding capacity (after inhalation and after exhalation) provide a quantitative measure to evaluate the breath holding time of the collegiate youths and the norms are also found gradable. Thus, the hypothesis – "H_1 –The normative scale would provide a quantity standard to measure the performance of collegiate students on breath holding capacity after inhalation and after exhalation" has been sustained. Therefore, the normative scale could provide a quantity of standard to measure the breath holding capacity of collegiate students.

Further, the result inferential statistics indicates that there was statistically significant difference in breath holding capacity of collegiate students after inhalation and after exhalation ($t=2.13$, $p<0.05$). This result in turn suggests that the null hypothesis- "H_O –There would be no difference in breath holding capacity after inhalation and breath holding capacity after exhalation" has been refuted.

Summary

The purpose of the study has been to assess the Breath holding capacity of the collegiate students of physical education in Pune city, whether the norms of breath holding capacity can be established and whether the breath holding capacity is more or less before exhalation and after exhalation. For this purpose, 300 subjects were selected as a sample. The age group of subjects has been ranged in between 22+ years. Considering the steps of normative study, the data have been collected by the researcher and analyzed through Mean, Standard Deviation, Percentile, and 't' test methods. The level of significance has been set at 0.05 level of confidence.

The finding of this study showed that the norms of breath holding capacity before-inhalation and after-exhalation can be applied to find the position of a breath holding related performance score in different sport events. Moreover, percentile norms (P_{99}, P_{75}, P_{50}, P_{25}, and P_{10} scores on breath holding capacity after inhalation were 92.47, 60.43, 46.81, 35.56 and 28.70, whereas the scores on breath holding capacity after exhalation were 92.11, 47.55, 37.08, 29.57 and 23.27 respectively) graded as per Likert's five point scale may be treated as indicator to one's anaerobic capacity related to sports performance and associated functional ability of circulo-respiratory system. However, accumulating evidence suggest that breath holding may be a useful method to help increase overall fitness abilities.

The result on comparative difference in breath holding time ($t= -6.6$, $p<0.05$) indicates that breath holding after inhalation was greater than after exhalation. This in turn suggests that retention of breath can initially be practiced after inhalation and after mastery over such practice breath-retention after exhalation may be practiced to enhance anaerobic capacity maximally, which in fact improves sports performance.

Although this study does not claim about its cure but firmly believes that progressive part of breath holding intervention may obviously increase capacity of collegiate students. However, other researchers being engaged with this field has also been benefited by the result of the present study.

Conclusion

Based on the findings of the study and within the limitations, the following conclusions were drawn-

- The norms of breathing holding capacity (after inhalation and after exhalation) are applicable to grade the collegiate students on their rich functional ability of circular-respiratory system which is useful for every sports person.
- Breath holding time after inhalation is higher than the breath holding time after exhalation.

Contribution to the knowledge

Literature revealed that several trails have been made so far on breath holding capacity along with moderate health of collegiate students. However, the quality of performance has been increased according to the increment of trail. This study contributed an evidence of trails on finding out the norms of breath holding capacity and the results have been found amazingly favourable among the collegiate students. This study, therefore, made a special contribution to the knowledge in the field of yoga and physical education in India.

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