CHAPTER - V

Dr. Kokardekar's Contribution To Evaluation In Physical Education

PART - II

Scientific Work of Dr. Kokardekar
Scientific Work Of Dr. Kokardekar

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PART II

Dr. Kokardekars Contribution to Evaluation in

Physical Education

Scientific Work of Dr. Kokardekhar

Introduction:

All the innovative and scientific works that Dr. Kokardekhar had carried out while holding various posts, such as Director of Physical Education, Nagpur University, Chief Organizer Physical Education, Government of C.P. and Berar, and as a life member of Hanuman Vyayam Prasarak Mandal, Amravati, etc. is to be studied with the object to estimate that extent of contribution he had made to the physical education in general and to the area of evaluation in physical education in particular.

Dr. Kokardekhar had employed his inquisitive mind in collecting information about the current trends and practices in physical education in different advanced countries by establishing "Physical Culture Information Bureau" at H.V.P. Mandal in the year 1927-28, i.e. before going to Germany. His selection for deputation to higher studies was made by the founders of the Mandal by judging his qualities.
While in Germany he was working under the guidance of Dr. Carl Diem, who further developed and nurtured his talents. Dr. Diem seemed to have provided full scope to Kokardekar in his studies. It was under the guidance of Dr. Carl Diem that Kokardekar had learnt modern research techniques. His original scientific work came out in Germany in the form of his first ever 'Koka' formula.

After return from Germany, Kokardekar seemed to have utilized his knowledge in exploring the areas like sports anthropometry and physical fitness. Several of his articles and papers based on the scientific data, that he had collected on Indian school children and collegiate youths, were published in regional newspapers and professional magazines of the period.

Much of the information about his work in Germany and that in India has been mentioned in earlier chapters¹.

A brief review of his scientific work and literary contribution will be useful in knowing his area of specialization and the advancement that he had made in the field of physical education.

4.1 Classification of Scientific Work and Literary Contribution:

From the available information it is possible to classify the areas in which Dr. Kokardekar had made his

¹Supra p-119.
contribution in the form of articles. The areas are:

1. Body type and proportion
2. Anthropometry
3. Growth and Development
4. Test and Measurement (Physical Efficiency Badge, Athletic Ability)
5. Classification
6. Health and Fitness
7. Nutrition
8. Postural defects

His literary contribution may be classified into three categories:

1. Popular articles (P.A.)
2. Critical articals (C.A.)
3. Research work (R.W.)

The scientific information derived from different authentic sources is presented in the artical form in a simple language to be easily understood by the common people. Such articals are considered 'Popular articals'.

The articals based on scientific information which when supported, criticised or compared with the information collected from local condition are considered 'Critical articals'.

Reporting in artical form of scientific information collected by the use of techniques such as observation, survey
and testing or by way of measurements, are considered research articals and such articals are attributed to the 'Research work'.

A chart showing the area-wise distribution of the articals published in various newspapers, magazines and scientific journals contribution by Dr. Kokardekar is presented at page No.134A.

4.2 Statement of Formulae:

Dr. Kokardekar had conducted testing programme of varied nature on school and college students. Out of these efforts he could develop standard norms in Track and Field events for high school students. He also succeeded in developing physical efficiency testing programme for college students, that was known as 'Physical Efficiency Badge'. Which was used in Nagpur University during the period 1937 to 1940.

Apart from his success in developing the above testing programme, he had devised a few formulae for the following purposes:

a) Formula to derive appropriate weight according to age and height.

b) Formula to know specific category of body type.

c) Formula to find out status of physical health.
<table>
<thead>
<tr>
<th>Body Type &amp; Proportion</th>
<th>Growth and development</th>
<th>Health and fitness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. पांची और नीचे दो मानसिक भावनाओं की सुंदरता (C.A.)</td>
<td>1. उद्धार और पुरूषों का विकास (C.A.)</td>
<td>1. अकस्मिक के अनुसार स्वस्थ अथवा बिनासी की स्थिति (C.A.)</td>
</tr>
<tr>
<td>2. अवयवों के विषय में प्राणिगत बदलाव (C.A.)</td>
<td>2. शारीरिक विकास (C.A.)</td>
<td>2. उपचार, बीमारी और वजन चिकित्सा (C.A.)</td>
</tr>
<tr>
<td>3. सुरक्षित रूप से नुकसान के स्वभाव (C.A.)</td>
<td>3. मानसिक विकास (C.A.)</td>
<td>3. प्रकृतिगत के अनुसार किया समर्थ का आयु (C.A.)</td>
</tr>
<tr>
<td>4. पूर्णता प्रमाणणबद्धता की कवरण (C.A.)</td>
<td></td>
<td>4. लड़कियों का अवसर (C.A.)</td>
</tr>
<tr>
<td>5. दाता स्वयंसेवक और लघुजीत (C.A.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. शरीर तौलना के समीकरण (C.A.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test &amp; Measurement</th>
<th>Nutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. उत्तेजन पानी उच्च भंड (C.A.)</td>
<td>1. आचार अवस्थाओं का विकास (C.A.)</td>
</tr>
<tr>
<td>2. वेगन के इंद्रियों में व्याख्या रचना (R.W.)</td>
<td>2. तड़के-तड़कियों पुरूषों में भंड (C.A.)</td>
</tr>
<tr>
<td>3. उच्च, उच्च नीचे, तल (R.W.)</td>
<td>3. भंड पश्चातंत्रिक विकास (C.A.)</td>
</tr>
<tr>
<td>4. मुख, मुख, विकास, बीजी ताल (R.W.)</td>
<td>4. सांस का निरंग (C.A.)</td>
</tr>
<tr>
<td>5. वेगन और उच्च के बीच सर्वसम्मत प्रमाण का तदन (R.W.)</td>
<td>5. नाटकाद्वारी का ध्वनि एवं बजन (C.A.)</td>
</tr>
<tr>
<td>6. केंद्रिक रूप से रात्रिक गुण रेखा उच्च एवं नीचे (R.W.)</td>
<td>6. आश्चर्यकोट्यां (C.A.)</td>
</tr>
<tr>
<td>7. वेगन, उच्च, अवरोध (R.W.)</td>
<td>7. शारीरिक जीवन (R.W.)</td>
</tr>
<tr>
<td>8. वेगन के गुण (R.W.)</td>
<td>8. चेतना जीवन (R.W.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Postural Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. लड़कियों के उच्च दोष (C.A.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. बड़ीकरण का लक्ष्य (R.W.)</td>
</tr>
<tr>
<td>2. बड़ीकरण उपाय (R.W.)</td>
</tr>
</tbody>
</table>

**Key:**
- C.A. = Critical article
- R.W. = Research work
- F.A. = Popular article
4.3 **Formulwise discussion:**

4.3.1 **Weight Formula**

A. \( H + \frac{C}{2} = w \) (Below 18 years)

B. \( H + \frac{C^7}{4} = w \) (18 to 25 years)

C. \( H + 2\frac{C^2}{3} (A-25) = w \) (Above 25 years)

Body weight has been considered an important parameter in the study of health, physical efficiency and sports performance. From the beginning of present century efforts were made by scientists and research-workers of different countries to find out the relationship of body weight with health and fitness of a person\(^1\).

Dr. Kokardekar had worked in this area and designed a formula to calculate an appropriate weight of a person by knowing his height, chest and age.

This formula was applicable in Nagpur University in three different forms:

a) **Prediction of appropriate body weight of the person below 18 years** (\( H + \frac{C}{2} = w \)).

b) **Prediction of appropriate body weight of 18 to 25 years age groups** (\( H + \frac{C^7}{4} = w \)).

c) **Prediction of appropriate body weight of the person above 25 years** (\( H + 2\frac{C^2}{3} (A-25) = w \)).

\(^1\)supra, Chapter 2, p. 35.
Discussion:

A) The first form of formula applicable to persons below 18 years of age indicates that the appropriate weight of a person is derived by the sum total of height and 1.5 chest where in height and chest girth are taken in inches and weight in pounds.

Suppose, a boy of 17 years is having height of 68 inches and his chest girth is 36 inches, his weight should be calculated as follows:

\[ W = 68 + 36 \times 1.5 \]
\[ = 68 + 54 \]
\[ = 122 \text{ Pounds} \]

In order to compare the weight derived from this formula with the standard weight table of LIC, a survey was conducted by the present research scholar during the year 1988-89 on 1079 students who were below 18 years of age. These students were ranging from 11 to 17 years and were belonging to local schools of Amravati city. Height, chest girth and actual weight were recorded with standard procedure\(^1\).

Comparative mean values indicating actual mean weight, mean of appropriate weight derived by using Koka formula and the mean of the weight as per LIC table are shown in following Table 1. Since the values of LIC table are mentioned in metric

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Kg unit, the ultimate values of mean body weight as calculated by Koka formula were also converted into kilograms by using the equivalence 1 Kg = 2.2046 lbs.

**Table 1**
Mean and SD of Body Weight of Below 18 years students.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Age (Yrs)</th>
<th>Actual Weight Mean (SD)</th>
<th>Koka Weight Mean (SD)</th>
<th>LIC Weight Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>29.903 (4.441)</td>
<td>41.329 (3.395)</td>
<td>35.300 (2.367)</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>32.069 (7.209)</td>
<td>42.687 (2.434)</td>
<td>38.800 (3.681)</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>34.740 (8.006)</td>
<td>43.960 (3.262)</td>
<td>39.086 (6.831)</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>40.193 (9.552)</td>
<td>45.187 (3.513)</td>
<td>39.512 (7.218)</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>42.630 (12.403)</td>
<td>46.593 (5.742)</td>
<td>41.904 (8.199)</td>
</tr>
<tr>
<td>6</td>
<td>16</td>
<td>57.268 (7.961)</td>
<td>52.302 (2.701)</td>
<td>52.370 (5.123)</td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td>58.789 (9.725)</td>
<td>52.048 (3.273)</td>
<td>53.800 (5.040)</td>
</tr>
</tbody>
</table>

**Note:**
1. While calculating mean body weight by Koka formula, the height and chest girth of each student were taken into account.
2. Similarly, while calculating mean body weight as per LIC table, the height factor of each student was taken into account.
Observations:

1. It is observed that the trend in mean body weight of the subjects ranging in age from 11 years to 17 years, shows steady increase.

2. The most significant aspect is observed in respect of age group of 16 years. Here, the weight derived by Kokardekar’s formula is almost the same as per Indian Standard Weight (LIC).

3. Upto the age from 11 through 15 years the body weight as per Koka formula shows higher values than the actual weight, but in case of remaining ages i.e. 16 and 17 years lower values are observed. The same trend is also seen in case of body weight mean as per LIC tables.

4. The mean values as per Koka formula are found higher than the mean values of body weight as derived from LIC tables, upto first five groups (11 to 15 years) but in remaining two groups the values show almost matching figures.

A graphical picture of the three mean values on the background of height parameter is shown below:
FIGURE 1
Comparative Mean Heights and Weights of...
B) The second form of the said formula was meant for predicting the appropriate weight of persons belonging to 18 to 25 years of age.

The formula was:

\[ H + C \frac{Z}{4} - W \]

Here, the significant change is seen in the constant value with which chest girth is multiplied. In earlier formula the constant value was 1.5, whereas here the value seemed to have slightly increased by only 0.25. The value is 1.75. Remaining structure of formula is the same.

Suppose, a young boy of 20 years enjoys height of 70 inches with his chest girth 38 inches, his appropriate weight is calculated as follows:

\[ W = 70 + 38 \times 1.75 \]
\[ = 70 + 66.50 \]
\[ = 136.50 \text{ lbs.} \]

This formula was brought into use in deriving the appropriate body weight of 2559 young men belonging to age group between 18 and 25 years. A normative survey was conducted on a geographically mixed population of this age group at Amravati. The subjects were belonging to different states of India representing different ethnic groups and cultural variations having come to Amravati for their education. Height, chest girth and actual weight of these
subjects were recorded according to chronology of their age with standard procedure as referred earlier.

The values of appropriate, body weight of each age group were derived by using Koka formula. Similarly, the mean value of actual weight of each age group was also computed. In order to make comparative picture more clear, the mean values of body weight of each age group were obtained by using LIC tables, and the weight table of World Health Organization (WHO) indicating international standards.

Thus, for each age group following four types of body weight mean were made available for comparison:

1. Mean of actual weight.

Comparative figures are shown in Table 2 against the background of body weight.

Observation:
1. It is observed from the Table 2 that the appropriate mean weight values of the age group from 19 to 25 years derived from Koka formula very much match with the mean weight values derived from LIC tables.
2. International standard of body weight appears on the higher side than the other two standards.

3. The mean value of actual body weight of 2559 subjects is observed to be lower than the other three values. These subjects are running underweight.

A graphical presentation of the four mean values as against the background to their body height parameter, is made below.

TABLE - 2

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Age</th>
<th>Actual weight mean (SD)</th>
<th>Koka weight mean (SD)</th>
<th>LIC weight mean (SD)</th>
<th>WHO weight mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>(285) 56.335 (10.263)</td>
<td>55.962 (4.073)</td>
<td>59.138 (7.387)</td>
<td>61.830 (4.762)</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>(268) 56.703 (9.762)</td>
<td>60.078 (8.329)</td>
<td>59.138 (9.271)</td>
<td>62.129 (6.328)</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>(268) 55.589 (10.673)</td>
<td>59.803 (7.629)</td>
<td>59.138 (8.367)</td>
<td>62.121 (7.832)</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>(314) 56.925 (9.790)</td>
<td>59.995 (6.321)</td>
<td>59.138 (7.932)</td>
<td>63.474 (5.921)</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
<td>(299) 56.968 (10.807)</td>
<td>59.611 (5.623)</td>
<td>59.138 (8.2810)</td>
<td>62.980 (7.621)</td>
</tr>
<tr>
<td>6</td>
<td>23</td>
<td>(352) 57.895 (11.317)</td>
<td>60.215 (6.371)</td>
<td>61.327 (7.631)</td>
<td>63.187 (5.214)</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>(317) 57.481 (9.718)</td>
<td>60.188 (7.932)</td>
<td>61.327 (9.101)</td>
<td>65.877 (4.832)</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>(245) 58.175 (11.298)</td>
<td>60.346 (6.831)</td>
<td>61.327 (8.219)</td>
<td>66.289 (5.431)</td>
</tr>
</tbody>
</table>
FIGURE 2

Comparison of mean weight, height and sit-walk.

18 to 20 years age group.

Mean Height and Weight

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>150</th>
<th>155</th>
<th>160</th>
<th>165</th>
<th>170</th>
<th>175</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Years

---

O--O A.M.
Δ--Δ B.M.
□□□□ N.W.
O--O U.W.
O--O Sit-Walk
c) The third form of the formula was developed for predicting the appropriate weight of the person above 25 years. The formula reads as follows:

\[ H + 2C + \frac{2}{3} (A - 25) = W \]

Here:

- \( H \) = Height in inches
- \( C \) = Chest in inches
- \( W \) = Weight in pounds
- \( A \) = Actual age

A careful observation of this formula reveals that it has given consideration to actual age, the chest is doubled but height factor remained unchanged.

To calculate the body weight of a person of 35 years with 65 inches height and chest being 40 inches, the formula is used as follows:

\[ 65 + 2 \times 40 + \frac{2}{3} \times (35 - 25) \]
\[ = 65 + 80 + \frac{2}{3} \times 10 \]
\[ = 65 + 80 + 6.7 \]
\[ = 151.67 \text{ lbs.} \]

To tally the result of this formula with the mean values of actual weight a normative survey was conducted on 682 subjects selected randomly from the age group 26 to 29 years. Necessary body measurements required for the use of Roka formula were recorded with standard procedure.
The values were entered into Koka formula and the appropriate weight of each person was obtained. Ultimately, the mean weight of 682 subjects as derived from Koka formula was obtained. Similarly, the mean of actual weight was also computed with the same procedure. The LIC tables and WHO weight tables were also used in deriving the mean values of body weight of the subjects.

The following Table no. 3 shows a comparative statement of the four types of mean body weight.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Age (n)</th>
<th>Actual weight mean SD</th>
<th>Koka weight mean SD</th>
<th>LIC weight mean SD</th>
<th>WHO weight mean SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26 (199)</td>
<td>58.154 (10.921)</td>
<td>64.538 (6.391)</td>
<td>61.327 (8.261)</td>
<td>68.289 (7.621)</td>
</tr>
<tr>
<td>2</td>
<td>27 (181)</td>
<td>58.156 (8.989)</td>
<td>64.906 (5.639)</td>
<td>61.327 (9.919)</td>
<td>68.408 (6.832)</td>
</tr>
<tr>
<td>3</td>
<td>28 (138)</td>
<td>60.052 (10.297)</td>
<td>65.960 (3.131)</td>
<td>63.366 (11.109)</td>
<td>69.207 (7.321)</td>
</tr>
<tr>
<td>4</td>
<td>29 (164)</td>
<td>59.925 (11.781)</td>
<td>66.149 (3.758)</td>
<td>63.935 (8.321)</td>
<td>67.873 (8.762)</td>
</tr>
</tbody>
</table>

Observation:

From the Table 3 it may be observed that mean weight of each category shows steady rise.
Actual weight in respects of each age group seems lower than the remaining three categories.

The weights derived from Koka formula are comparatively higher than actual weight and LIC table weight.

International weight tables of WHO show considerable higher values of body weight of each age group under study.

4.3.2 Formula for classifying the normal physique:

A very simple formula for classifying the normal physique into seven categories was evolved by using only three parameters viz. weight, height and chest. The formula reads as follows;

\[ W = (H + C) = \text{Chest or score} \]

\[ W = \text{Weight in lbs} \]

\[ H = \text{Height in inches} \]

\[ C = \text{Normal chest girth in inches} \]

This formula is stated to be valid for the persons below 25 years of age.

Another variation of formula was suggested for the persons above 25 years of age. The formula reads as follows;

\[ W - \left\{ H + C + \frac{2}{3} (A-25) + \left[ 7 - (c-ab) \right]^2 \right\} \]

\[ W = \text{Weight in lbs} \]

\[ H = \text{Height in inches} \]

\[ C = \text{Chest girth in inches} \]

\[ A = \text{Actual age} \]

\[ ab = \text{Abdomen girth in inches} \]
The score derived from the formula was made a determining factor in classifying a physique of a person into seven categories\(^1\) in respect of health, physical efficiency and fitness.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scores</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41 and above</td>
<td>Best class</td>
</tr>
<tr>
<td>2</td>
<td>34 - 40</td>
<td>Better class</td>
</tr>
<tr>
<td>3</td>
<td>27-33</td>
<td>Good class</td>
</tr>
<tr>
<td>4</td>
<td>20 - 26</td>
<td>Normal class(Fair)</td>
</tr>
<tr>
<td>5</td>
<td>13 - 19</td>
<td>Weak</td>
</tr>
<tr>
<td>6</td>
<td>6 - 12</td>
<td>Very weak</td>
</tr>
<tr>
<td>7</td>
<td>5 and below</td>
<td>Miserable</td>
</tr>
</tbody>
</table>

It is clear that the weight, height and chest have been given much significance in both the formulae. Age and abdomen were considered in the case of persons above 25 years. However, common scores were prescribed for both the formulae. An illustration of each one will further clear the concepts.

**Below 25 years:**

A boy of 20 years with 64 inches height and 32 inches chest and having 110 pounds weight will have his category calculated as follows:

\[
W - (H + C) = \text{Scores} \\
110 - (64 + 32) \\
110 - 96 = 14
\]

\(^1\)Student's Guide to Physical Education, Nagpur University, Board of Physical Welfare, Nagpur, 1937, p. 20.
The score 14 shows that the person belongs to weaker category. With the help of this formula one can know the category of his physique. This is meant for the people below 25 years.

For those above 25 years the formula with variation is used. For example a 32 years old person having weight 140 pounds with height 66 inches and chest 33 inches with abdomen 30 inches will have his category calculated as follows;

\[ W = \left( H + C + \frac{2}{3} (A - 25) + [7 - (c-ab)]^2 \right) \]
\[ 140 - \left( 66 + 33 + \frac{2}{3} (32-25) + [7-(33-30)]^2 \right) \]
\[ 140 - \left( 99 + \frac{2}{3} (7) + [16] \right) \]
\[ 140 - (115 + 4.66) \]
\[ 140 - 119.66 = 20.34 \]

The value of 20.34 indicates the category of normal class as per the scoring table.

**Discussion:**

During the period between 1930-1940 some outstanding work at international level in the field of classification of physique was attributed to the personalities like McCloy, Neilson and Cozen, Sargent, Bookwalter etc. They had used age, height and weight as a basis for the construction of their formulae. McCloy had three variations of his formulae meant, respectively for:
1. High school student$^1 = (20 \times \text{age}) + (6 \times \text{height}) + \text{weight}$

2. College men$^2 = (6 \times \text{height}) + \text{weight}$

3. Elementary school$^3 = (10 \times \text{age}) + \text{weight}$.

His formulae have been extensively used for physical education classes and also for the formation of homogeneous groups in a research design of experimental study.

In none of the contemporary works under review chest and abdomen have been used as the parameters for classification.

On the background of this work, the formulae that were developed by Dr. Kokardekar during the period under review, seemed to have been comprehensive due to two of its specialities viz.

1. The use of chest and abdomen measurements in addition to the three factors i.e. age, height and weight, and

2. The formula is open to higher age groups i.e. above 25 years.

Inclusion of chest and abdomen in the formula might be with purpose of bringing more accuracy in formula of classification of the persons above 25 years. Chest and abdomen do make difference in physique after the age of 25 years when the difference between the two is likely to


$^2$Ibid.

$^3$Ibid.
shorten. It is observed that the abdominal girth increases rapidly as the age advances after 25 years.

The first formula that was recommended for classification of the students below 25 years includes only three parameters viz. height, weight and chest. In this formula chest and abdomen girth are excluded for the reasons probably that there is remote possibility of increasing abdominal girth during the period between 18 to 25 years. It is learnt that both of these formulae were developed by Kokardekar in 1936–37 and after conducting extensive survey over 2000 college students and adults in India during the period between 1938–39 those two were verified with regard to their validity and reliability.

4.3.3 Formula of Physical Fitness Status

This formula was used for predicting the status of physical health and work efficiency and thereby physical fitness of a person by using the growth parameters like height, weight, chest and abdomen. The formula reads as follows;

\[
A) \quad \frac{W}{(H)^2} \times \frac{85}{100} \times \frac{C}{A} = \text{Score}
\]

---

1H.V. Deshpande, "Vyayaam Tatwa Darshan", Amravati, H.V.P.M., Oct. 1946, p. 74.
If the abdomen is less than chest.

and

\[
B) \quad \frac{W}{(H)^2} \times \frac{85}{100} \times \frac{A}{C} = \text{Score}
\]

If the abdomen is more than chest

\[
W = \text{Weight in Kg}
\]

\[
H = \text{Height in cm}
\]

\[
C = \text{Chest girth in cm}
\]

\[
A = \text{Abdomen girth in cm}
\]

These (A and B) are the two versions of the formula. In this formula the chest girth and abdomen girth have been used for the first time for the prediction of physical health and efficiency of a person. By putting the values of the growth parameters into the formula, the sum is to be solved. It is claimed that if the answer comes to the value of two or more, it indicates sound physical health and higher level of work efficiency. But, if the answer is below the value of two, it would indicate lower standard of physical health and efficiency.

In construction of this formula Kokardekar had made use of chest-abdomen ratio. Infact, this formula seemed to be the modified and improved formula of Kolrouch and Copp of Berlin University. The formula developed by Kolrouch was as follows;

\[
\frac{\text{Weight in Kg}}{(\text{Height in cm})^2} = 2
\]
The answer two and above indicates proportionate development, fitness and efficiency. The answer going down below two indicates fall in work efficiency.

During the period between 1920 to 1930 the German and American Sports Scientists had developed various formulae with the objects of predicting proportionate growth, physical fitness, health and work efficiency. In all these formulae the growth parameters like body weight, chest girth, height were used. These formulae proved inadequate for the proper prediction of the above factors. By identifying the flaws in the then existing formulae, Kokardekar realised the need for establishing chest-abdomen ratio and introducing it into the formula for Kolrouch.

The chest abdomen ratio speaks of Cardio-respiratory efficiency. Larger chest provides greater air volume to lungs and more space for movement. Shorter abdomen girth indicates lack of muscular bulk amounting to lesser fat percentage. Person with large abdominal girth possesses excess of fat, which affects his work efficiency. Excess of fat on the body is considered harmful to health, as per the principles of Ayurved and also modern medical science. During the course of time Kokardekar worked out a definite chest-abdomen ratio by studying the ancient Indian texts on Ayurved, Shukra Samhitâ, Brihat Samhita, etc. in which anthropometric measurements of various parts of proportionate body are described; and by actual recording the chest abdomen measurements of the old Greco-Roman sculptures placed in German museums.
With all these documentary evidences he made certain revealing observations. According to him, the difference between the chest and abdomen circumference should be 7 inches i.e. the abdominal girth shorter by 7 inches than the chest girth.

The ratio of 100:80 is for the person with single frame and it should be 100:85 for the person of doubled frame constitution of his body. Following illustration will make the concept of the formula and its use more clear.

A person with a height 175 cm and weight 70 kg is having his chest and abdominal girth 87 cm and 77 cm respectively. By putting these values in the formula the following sum is formed;

\[
\frac{\text{Weight in Kg.}}{(\text{Height in cm})^2} \times \frac{80}{100} \times \frac{C}{A}
\]

\[
\frac{70,000}{(175)^2} \times \frac{80}{100} \times \frac{87}{77} = 2.066
\]

As, the reply is above the value of two, it is inferred that the person appears physically healthy, fit and efficient.

By reducing the weight and other growth parameters of a person, the formula will have its reply less than two indicating the poor health and lesser work efficiency. For
example, a person with 55 kg weight and 170 cm height is having his chest and abdomen girth 75 cm and 70 cm respectively.

\[
\frac{55,000}{(170)^2} \times \frac{80}{100} \times \frac{75}{70} = 1.631
\]

Although the formula is useful in predicting physical health and work efficiency of a common man, it is not applicable for the person with excess body weight than the normal. It is noted to be the limitation of this formula.

Now, that to infer about physical health and work efficiency of any person with the help of their formula and without any practical test would be less reliable to test the reliability of formula by finding out relationship between the calculated value of the formula and the work efficiency of a person. This would be possible by collecting information from the large population. In this study on specific population, those who cross the value of 2.00 as per the formula, they should be tested for their physical efficiency with the help of some standard test. If such people record better performance in their physical efficiency test, then there is a ground to establish the positive relationship between the two and further to establish reliability of Kokardekar formula.

Similarly, the health status of such persons be examined to find out truthfulness of the formula.
4.4 Allied Work

Authentic references are available about some additional scientific work that was carried out by Kokardekar. This work was considered to be supplementary to the already referred work that was in the form of certain formulae. A short review of this allied work is taken here below;

4.4.1 Method of forming homogeneous groups on the basis of Exponent numbers

For running a programme of physical education in school, it is necessary to formulate homogeneous groups of the students, because of the inherent differences in them in respect of their age, height and weight. To form the group on the basis of any one will not make homogeneity of the group. By using all the three parameters an effective method could be evolved of forming homogeneous groups.

In this direction, Kokardekar had improved a method of forming homogeneous groups on the basis of exponent numbers. These exponent numbers are to be calculated from a sequence of serial number from 1 to 18. Each number is based on and represents certain specific range of age, height and weight as shown in the Table 5. For example No.1 represents age of 10 to 10.5 years, weight ranges from 55 to 60 lbs and height is between 50 to 51 inches. Boys having their age, height and weight within this specific range will be allotted respective exponent number. In case of gross variation of the three parameters representing different numbers, the total of these
numbers will be made and then the figure derived from the total will represent his exponent number.

Division of eight groups is made on the basis of specific range of exponent numbers e.g. exponent numbers from 10 to 14 come under one group. Those students who obtain their exponent numbers within this range, will be entitled to join the group.

The table of exponent number along with the method of division, as developed by Kokardekar, is presented below.

**Table 5**
A ready reckoner for knowing exponent number.

<table>
<thead>
<tr>
<th>Number</th>
<th>Age</th>
<th>Weight (lbs)</th>
<th>Height (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 to 10.50</td>
<td>55 to 60</td>
<td>50 to 51</td>
</tr>
<tr>
<td>2</td>
<td>10.6 to 10.11</td>
<td>61 - 65</td>
<td>52 - 53</td>
</tr>
<tr>
<td>3</td>
<td>11 to 11.5</td>
<td>66 - 70</td>
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<tr>
<td>4</td>
<td>11.6 to 11.11</td>
<td>71 - 75</td>
<td>54 - 55</td>
</tr>
<tr>
<td>5</td>
<td>12 to 12.5</td>
<td>76 - 80</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>12.6 to 13</td>
<td>81 - 85</td>
<td>56 - 57</td>
</tr>
<tr>
<td>7</td>
<td>13 to 13.5</td>
<td>86 - 90</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>13.6 to 13.11</td>
<td>91 - 95</td>
<td>58 - 59</td>
</tr>
<tr>
<td>9</td>
<td>14 to 14.5</td>
<td>96 - 100</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>14.6 to 14.11</td>
<td>101 - 105</td>
<td>60 - 61</td>
</tr>
<tr>
<td>11</td>
<td>15 to 15.5</td>
<td>106 - 110</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>15.6 to 15.11</td>
<td>111 - 115</td>
<td>62 - 63</td>
</tr>
<tr>
<td>13</td>
<td>16 to 16.5</td>
<td>116 - 120</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>16.6 to 16.11</td>
<td>121 - 125</td>
<td>64 - 65</td>
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<td>15</td>
<td>17 to 17.9</td>
<td>126 - 130</td>
<td>66 - 67</td>
</tr>
<tr>
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<td>17.6 to 17.11</td>
<td>131 - 135</td>
<td>68</td>
</tr>
<tr>
<td>17</td>
<td>Above 18</td>
<td>Above 136</td>
<td>60 and above</td>
</tr>
<tr>
<td>18</td>
<td>Above</td>
<td>Above</td>
<td>Above</td>
</tr>
</tbody>
</table>


**Division of groups**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Scores</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Below 0</td>
<td>(A)</td>
</tr>
<tr>
<td>2</td>
<td>10 - 14</td>
<td>(B)</td>
</tr>
<tr>
<td>3</td>
<td>15 - 19</td>
<td>(C)</td>
</tr>
<tr>
<td>4</td>
<td>20 - 24</td>
<td>(D)</td>
</tr>
<tr>
<td>5</td>
<td>25 - 29</td>
<td>(E)</td>
</tr>
<tr>
<td>6</td>
<td>30 - 34</td>
<td>(F)</td>
</tr>
<tr>
<td>7</td>
<td>35 - 38</td>
<td>(G)</td>
</tr>
<tr>
<td>8</td>
<td>above 38</td>
<td>(H)</td>
</tr>
</tbody>
</table>

**Example**

A boy of 14 years with 66 lbs weight and 53 inches height will have his exponent number calculated as follows;

- **Age** - 14 years = 9
- **Weight** - 66 lbs = 3
- **Height** - 53 inches = 2

Total = 14

The score 14 shows that the boy belongs to B group.

It has been hinted that this method need not be used for the formation of groups while conducting mass calisthenics or aerobic exercises on a single class. But when the physical education programme is to be executed on entire population of students in the school where necessary facilities are available, this method can effectively be used.
This is also recommended for conducting P.T. or physical education programme at collegiate level.

4.4.2 Development of Physical Efficiency Test Battery With Norms for Students of Various Age Groups:

Dr. Kokarkekar had not only devised the method of forming homogeneous groups for the conduct of the physical education programme in school, but also developed the test batteries for assessing physical efficiency of the school students ranging from 8 to 13 years and also the battery of test items for high school students. It is revealed from the available literature that the scoring tables were formulated on percentile basis for knowing the level of physical efficiency of the school students.

As per the source literature\(^1\) there are three test batteries developed by Kokarkekar for the following three categories of students.

1. Up to 12 years.
2. 13 years and above.
3. High school level (15 years and above).

---

\(^1\)H.V. Deshpande, "Vyayam Tatwa Darshan", Amravati, H.V.P.M. Oct. 1946, p. 109.
Each test battery has four events with option for certain events. The batteries are mentioned below with the performance of qualifying standard.

1. Up to 12 years:
   i) Chin-up (4 times)
   ii) S.L.J. (5'9"
   iii) 60y.run (9 sec.) or 50y.run (8 sec.)
   iv) Cricket Ball throw – (130')

2. 13 years and above:
   i) Chin-up (6 times) or Rope (16')
   ii) S.L.J. (6'6") or R.L.J. (12')
   iii) 60y.run (8 sec.) or 100y.run (13'2 sec.)
   iv) C.B. throw (195')

3. High School level (15 years and above)
   i) Chin-up (9 times) or Rope (16')
   ii) R.H.J. (4'4") or R.L.J. (14')
   iii) 220 y. run (28 sec.) or 100 y. run (12'3 sec.)
   iv) C.B. Throw (220') or 8 lbs. shot (28')

**Scoring Tables:**

Along with the test batteries and their qualifying marks, it is revealed that Kokardekar had also worked on Indian students and developed scoring table on percentile basis for various items of test batteries as an aid to make self assessment percentile of one's own physical efficiency. With the help of this table one can very well find out the level of physical efficiency achieved by him.

The scoring are presented in Page No. 159 to 160B.
| नंबर | घर | दर्जन | योगदान | विभाग | लंबी कुदी | छात्रवृत्ति | ठोरे के साथ उंची कुदी | ठोरे के साथ लंबी कुदी | क्रिकेट में देखभाल | भूवैद्य के साथ देखभाल | शाखा | 
|------|-----|-------|---------|--------|------------|-------------|-----------------|-----------------|-----------------|-----------------|-------|-------|-------|-------|
| 1    | 5-0 | 10-8  | 20-8    | 10-8   | 2-0        | 3-0         | 100             | 18-0            | 40              | 20              |       |       |       |       |
| 2    | 5-1 | 10-10 | 20-10   | 10-10  | 2-1/2      | 3-1/2       | 104             | 17-6            | -               | 21              |       |       |       |       |
| 3    | 5-2 | 11-9  | 21-0    | 11-0   | 2-1        | 3-1         | 108             | 19-0            | -               | 22              |       |       |       |       |
| 4    | 5-3 | 11-2  | 21-2    | 11-2   | 2-1/2      | 3-1/2       | 112             | 19-6            | 39.4            | 23              |       |       |       |       |
| 5    | 5-4 | 11-4  | 21-4    | 11-4   | 2-2        | 3-2         | 116             | 20-0            | -               | 24              |       |       |       |       |
| 6    | 5-5 | 11-6  | 21-6    | 11-6   | 2-2        | 3-2         | 120             | 20-6            | 39.3            | 25              |       |       |       |       |
| 7    | 5-6 | 11-8  | 21-8    | 11-8   | 2-3        | 3-3         | 124             | 21-0            | -               | 26              |       |       |       |       |
| 8    | 5-7 | 11-10 | 21-10   | 11-0   | 2-3        | 3-3         | 128             | 21-6            | -               | 27              |       |       |       |       |
| 9    | 5-8 | 12-0  | 22-0    | 12-0   | 2-4        | 3-4         | 132             | 22-0            | 39.2            | 28              |       |       |       |       |
| 10   | 5-9 | 12-2  | 22-2    | 12-2   | 2-4/2      | 3-4/2       | 136             | 22-6            | -               | 29              |       |       |       |       |
| 11   | 5-10| 12-4  | 22-4    | 12-4   | 2-5        | 3-5         | 140             | 23-0            | 39.1            | 30              |       |       |       |       |
| 12   | 5-11| 12-6  | 22-6    | 12-6   | 2-5 1/2    | 3-5 1/2     | 144             | 23-6            | -               | 31              |       |       |       |       |
| 13   | 6-0 | 12-8  | 22-8    | 12-8   | 2-6        | 3-6         | 148             | 24-0            | -               | 32              |       |       |       |       |

19
<table>
<thead>
<tr>
<th>गण</th>
<th>द्वार पर बाजार</th>
<th>सिंगल बाजार</th>
<th>सिंगल लंबी</th>
<th>लंगातार 2</th>
<th>चलाने वाले क्षेत्र</th>
<th>दोहर के साथ</th>
<th>क्षेत्र के मध्य</th>
<th>दोहर के साथ</th>
<th>क्षेत्र के मध्य</th>
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<th>प्रति मौसम को फेमके</th>
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4.5 Valuation of Dr. Kokardekar's Contribution:

The scientific work undertaken by Kokardekar was mainly related to the field of evaluation. Developing tests with norms of physical efficiency for students of different age groups, devising formula for estimating one's own appropriate weight, suggesting the new method of classification of students, and the method of forming of homogeneous groups, preparing the table of standard norms of physical efficiency for students of different age groups, etc. are some of the meritorious works carried out by Dr. Kokardekar in a short span of five to six years.

In order to complete the scientific work of the type mentioned above, needless to say that the work is an output of hard and innovative efforts. A survey of large and selective sampling was needed, measurements of different body parts on a large sampling certainly involves collection of huge numerical data, which needs careful handling with appropriate statistical techniques for coming to logical conclusions.

Magnitude of the manifold efforts in this scientific exercise increases when visualised on the background of the situation and the conditions that were existing 50 years ago, where modern tools and sophisticated machines for dealing with the numerical data were not available. Entire statistical work must have done manually.
The scientific work had its application mainly on the students population, right from primary to collegiate level. The test batteries with standard norms were developed by Kokardekar for the students of different age groups. The efficiency test that was developed for the students of Nagpur University, was in practice in the University for pretty long time. The cross section of students population that was covered by him in his work and the type of evaluation technique developed by him for different levels of students is worth to be taken note of.

Apart from the development of test batteries for students population, the formulae of calculating appropriate weight and those for assessing one's own physique, were useful for a common man. By using this formulae one could know about one's own health, fitness and physique. Thus, it may be significant to note that a large section of population was used by him in his work and for each category of population some useful technique of evaluation was developed by him.

The scientific work that was carried out by Kokardekar, was mainly in India for which Indian population was used as sample. Therefore, the norms of physical efficiency for different age groups were truly applicable for the students and youths of India. This work was carried out by him during the period from 1935 to 1942, which may be considered pioneering work in physical education in India.
SUMMARY

The concept of personality and its influence on society or institution to which it belongs has long been an area of interest to researchers in the field of education in general and social psychology in particular. Personality dynamics is a special branch of social psychology, wherein various dimensions of personality and their relationship with society are studied.

There is inseparable interrelationship between the personality and its society. Both are complimentary to each other, being influenced and benefitted by each other.

Several research studies have been completed with the object to identify the personality variables responsible for the individual performance of person in different areas. Much of the research work completed by psychologists indicate that a person differs from other individuals in personality; i.e. there is individual difference in the development of personality.

Personality is one of the broader dimensions in the study of human behaviour. Rather, it is a global picture which tries to encompass both physical as well as psychological characteristics of an individual which governs his behaviour.
L.J. Kokardekar was a personality of third decade of the current century, who was highly qualified in the profession and had worked for physical education in erstwhile C.P. and Berar province (the present Madhya Pradesh and Vidarbha part of Maharashtra) of Central India. He was pioneering Director of Physical Education in the University of Nagpur. Several references are found of his name in the State Government reports, Nagpur University reports and in other documents and correspondence. The scientific work that was carried out by him, was reflected in his writings in the contemporary magazines and newspapers, so also in the annual reports of the Board of Physical Welfare of Nagpur University. He was short lived, as he met with a fatal accident in the year 1943 when he was only 40 years of age. He was closely associated with Hanuman Vyayam Prasarak Mandal, Amravati - the voluntary social institution of Central India working in the field of Physical Education.

The purpose of the study was to evaluate personality of Kokardekar and study his contribution to the field of physical education.

Considering the title and in view of its objectives, the study was divided and conducted in two parts:

Part I : Personality Study of Dr. L.J. Kokardekar
Part II : Critical appraisal of his scientific work.
The information about personality of Kokardekar and his biography was collected from the authentic sources of two types:

1. **Literary sources** like magazines, office record, letters correspondence, books and reports.

2. **Resource persons** - The individual persons of the contemporary period, who were in contact with Kokardekar and his blood relatives, were interviewed and the information of Kokardekar was thus collected from them.

The information was further processed, classified and arranged to draw a biographical sketch of Dr. Kokardekar. From this biographical sketch further study was made of his personality traits and dimensions. Ultimately a personality profile of Dr. Kokardekar was emerged out of the whole biographical study.

**Biographical Sketch**

Biographical study of L.J. Kokardekar reveals that his personality was a unique one not only because of his outstanding work in the field of physical education, but also his active involvement in other walks of life.

His individual self was greatly influenced by the towering personalities like Mahatma Gandhi, Sardar Patel,
Kaka Kalelkar and such others, in whose contact, he was during the formation period of his early youthful life at the Sabarmati Ashram. It had helped him to broaden his outlook and brought in his life two vital qualities: Simplicity of life and love for the people of the nation.

His close association with Dr. Carl Diem, the stalwart in physical education of Germany had developed in him the aptitude, knowledge and skill required for conducting scientific research in physical education.

If his stay in Sabarmati Ashram had broaden his outlook from regional to national level, his stay in Germany had given him further insight and broader vision of international magnitude.

His life-story is not smooth like an ordinary person, nor is there any thrill, suspense or misery in it. It is somewhat Kaleidoscopic in nature. He had to face lot of turning points in his life. In early childhood he was forced to leave his house in village for his education. He had to desert his school education for his participation in National Freedom Movement. He was one of the volunteers of the local political leaders. He also worked as school teacher for some time. He developed close association with Hanuman Vyayam Prasarak Mandal, Amravati. He was deputed to Poona for undergoing special training in printing technology. No sooner he could establish a printing press at
Amravati for H.V.P. Mandal and follow the printing profession, destiny changed his life-line. He was selected by H.V.P. Mandal, Amravati for going abroad for higher studies in physical education. He spent three and half years in Germany. It was again a turning point in his life. He became pucha professional person in physical education. On his return from Germany, he served the profession for only a decade, but with full devotion and commitment, in the capacity as the first Director of Physical Education of Nagpur University and later on for some time as a Chief Organizer of Physical Education, C.P. and Berar State. His contribution to the profession was no doubt, valued to be great, but somehow or the other the reasons best known to the history, his work and contribution remained closed into darkness of time for about half a century.

While he was climbing the steps on the ladder of success in life and achieving its height, the destiny fell on him. He met a tragic death in April 1943 at Nagpur.

**Work and Contribution of Dr. Kokardekar**

The second part deals with study of the scientific work of Dr. Kokardekar. In this part a bibliography of the articles contributed by him was prepared. Apart from the study of literary contribution, careful observation of different formulae suggested by him, was made, which
included the formula of calculating appropriate weight, formula for classifying the normal physique, and formula of physical fitness status.

It was further noted that Kokardekar had to his credit the development of physical efficiency test batteries with norms for the students of various age-groups and the method of forming homogeneous groups with the help of exponent numbers. A short review of his work was taken in the study. Summary of his scientific work and contributions is given hereunder.

**Work and Contribution of Dr. L.J. Kokardekar to the field of physical education:**

1. Development of the formula for calculating proportionate body weight based on some selected anthropometric parameters.

2. Development of the formula for the classification of students into homogeneous groups for the conduct of physical education classes.

3. Development of the formula based on anthropometric measurements for identifying better physique coupled with physical efficiency.

4. Development of the physical efficiency test battery with norms for the students of different age groups.
5. Organization of the department of physical education and development of the programme of physical education and sports for Nagpur University students.

6. Introduced annual system of physico-medical examination for the students of Nagpur University.

7. Contributed in local newspapers and magazines several articles on the subjects related to health, sports and physical education.

8. Organized district and state level tournaments and competitions in several sports.

9. Developed and maintained contacts with National and International Olympic Committees.

10. Instrumental in the formation of district and state level sports into fold of people of different occupations for carrying sports and physical education movement in the province.

11. Contributed substantially in shaping and designing the traditional system of physical culture developed at H.V.P. Mandal Amravati and in projecting the same from international platform.

12. Designing the schemes of physical education for secondary schools at district and provincial level.
Recommendations

The present study consists of two parts: Biographical study of the personality of Dr. L.J. Kokardekar and the study of his contribution to the field of physical education. The study reveals many more facts about the life of Dr. Kokardekar, and his contribution. It has also brought on surface certain problems for the consideration of future research workers, which are presented herebelow:

1. Biographical studies of some selected personalities of the field of physical education be undertaken. The personalities which had done Yeoman’s service on voluntary basis to the profession before independance are less known to the people. Their contribution may be made known, and history of physical education be rewritten.

2. Dr. Kokardekar had designed various formulae. Some of them were also brought into use in schools and colleges during his period. But, now after the lapse of 50 years it is necessary in the present context to verify them by testing their reliability and validity. with modern computerised techniques and to test its applicability in the present context.

3. Dr. Kokardekar had developed the norms of physical efficiency test battery for the students of schools and colleges. These norms need revision in the present context. A longitudinal study with large sampling be undertaken to verify and update the norms.
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