INFLUENCE OF MIZAJ ON REACTION TIME AND NEUROMUSCULAR COORDINATION USING RULER DROP METHOD IN COLLEGE STUDENTS

Iqra Hashmi[1]* and Yusuf Jamal[2]

[1]Assistant Professor (Physiology), Mohammadia Tibbia College and Assayer Hospital, Malegaon, Maharashtra-423203.

[2]Professor (Physiology), A and U Tibbia College, Karol Bagh, New Delhi-110005.

*Corresponding Author

Dr. Iqra Hashmi

Assistant Professor (Physiology), Mohammadia Tibbia College and Assayer Hospital, Malegaon, Maharashtra-423203.

ABSTRACT

Background: This cross-sectional descriptive study, conducted at Ayurvedic and Tibbia College and Hospital, aimed to establish reference standard norms for Reaction Time (RT) using the Ruler Drop Method (RDM) among college students aged 18-30. The study involved 155 participants, assessing their mizaj (temperament) through a questionnaire based on Ajnas-e-Ashra. **Methods:** Participants underwent RT evaluation using the RDM, with results presented in distance traveled and converted into response time. The study assessed significant differences in RT among the four mizaj groups (Safra, Damvi, Balghami, Saudavi) and explored potential variations between males and females. **Results:** Findings revealed noteworthy differences in RT among mizaj groups, with Safravi exhibiting the highest median RT, followed by Damvi, Balghami, and Saudavi. Post hoc analysis highlighted significant RT differences between Safravi and Balghami, as well as Safravi and Saudavi. No significant RT difference was observed between males and females. **Conclusions:** The study contributes valuable normative data for mizaj and RT, suggesting that individuals with Safravi and Damvi mizaj exhibit faster RT compared to those with Balghami and Saudavi mizaj. The RDM emerged as a cost-effective alternative for assessing RT in a college setting. The study underscores a correlation between mizaj, following Unani medicine principles, and RT, emphasizing the role of temperament in motor response. Future studies should consider additional variables, such as socio-demographics and IQ, for a more comprehensive understanding.

1. INTRODUCTION

Reaction time (RT) is defined as the interval of time between the presentation of a stimulus and the appearance of an appropriate voluntary response in a person. Also defined as 'the interval of time between application of stimulus and detection of a response.[2] It measures the cognitive functioning of an individual.[3,4,5] This response time substantially depends on the type, number and duration of possible stimulus.[6] The time interval between the stimulus applied and the response generated is Reaction time. It has been extensively used in the past decades to assess neuropsychological functions, motor cognitive processing and executive attention.[7,8,9] Motor-cognitive response time is expressed as RT, which represents both the speed of information processing and the motor response of coordinated peripheral movements.[21]

RT varies with several possible valid encouragement, type, order and intensity of encouragement, thrill, age, gender, physical fitness, hand dominance, practice and error, fatigue, fasting, distraction, alcohol, cutlet earthquake, stress, medicines, intelligence, learning complaint, brain injury, illness, personality type, delicacy in hail and vision.[1,6] A psychologist F.C. Donders in 1868 performed the first clinical examination of RT. He defined RT as the Speed of Mental Processes and assessed using nerve conduction velocity using the 'subtractive method'. In his study, he gave an electric shock to both feet of the subject randomly as a stimulus to infer how much time was needed for comparing the tasks, such as identification, comparison or other higher-level judgments. The subject responded to the stimulus by pressing the telegraph key with his left or right hand concerning the leg in which the shock was received.[2,5,10,11] latterly in the time 1930 the 'father of ultramodern psychology' William Wundt, along with his scholars, extended the subtractive system into experimental psychology and also they set up a new operation where RT was estimated once the encouragement was linked through which they measured the duration of internal processes, attention, memory, and the integration of the ideas. They estimated attention or apprehension span in the form of results.[5,12]

In the year 1938 Julia from the University of Minnesota found the relation of RT of 5-year-old children to various factors by using Mill's reaction board with an accessory key and she aimed to find the speed of reaction to auditory stimuli about their sex, intelligence and work status. In this study, she selected 50 girls and 50 boys of age five years five months to five

years seven months. During the procedure, the main board of the apparatus was held by the experimenter and the part was placed in front of the child. The Experiment consisted of 25 trials in which the children were divided into groups of five trials and the first three groups of tests performed for the rest of 15 min; the fourth and fifth groups of tests conducted with the rest of 30 seconds each.[13]

RT was also assessed by using a mobile phone with a test battery installed. Kaisa Rolig in her thesis estimated the feasibility of mobile phones in the calculation of RT. Now a day mobile have become an important part of life hence reducing the cost-effectiveness or the subjects. The subject can repeat the measurement whenever required. But these measurements vary from laboratory measurements with a controlled environment also the structure of each model of phones and their software vary from one another. There is also a comparatively small screen and buttons when compared with computers.[14]

RT is typically assessed using computerized neuropsychological testing soft-ware[15] However, high cost and requirements for professional management in estimating RT make this method inapplicable in a college setting. A simple, less precious measure of RT that can be used to replace the computer assessment is the traditional sovereign drop test (RDT) and, although the RDT measures RT plus movement time, it continues to be a respectable means of measuring simple RT.[17] The RDT has acceptable reliability and criterion validity[18,19] and RDT reliability in preschool children has previously been reported. Eckner et al validated this RDM through their observational study on evaluating a clinical measure of RT, where he evaluated the RT of 65 healthy individuals with a mean age of 45.5 years and right-hand dominants by RDM. They found excellent inter-rater (ICC= 0.92) and test-retest (ICC = 0.86) reliability.[19] Later Eckner et al evaluated the RT of Division I Football Players from the National Collegiate Athletic Association by RDM. He selected Cog State Sport tests and passed 68 athletes aged between 18-23 years. The study aimed to compare RT by RDM (RTclin) with RT by computer (RTcomp) with a neuropsychological test battery installed. This computer monitor consists of playing cards in the middle with an inverted face. Athletes should press the key 'K' as quickly as the card turns upward. They conclude that there is a positive correlation between RTclin and RTcomp (r =0.44).[20] Mizaj (disposition) is one of the abecedarian generalities of the Unani system of drug, opinion and line of operation of any complaint is grounded upon it. Every mortal being has been furnished with a specific mizaj through which organs and systems of an individual perform his functions properly.[22]

Internal and external causes influence the mortal body leading to su' mizaj (Altered disposition) that eventually induces the whole body or a specific organ in the form of complaint. The principle of operation of the complaint is to correct the altered disposition. Therefore, before commencing any treatment, mizaj of a patient or organ has to be evaluated.[23]

The notion of body fluids, or humour, or Akhlat (singular khilt), was established by the Unani physician Hippocrates (460 B.C.) in his book "Human Nature." According to this theory, the human body has four main types of humour: dam (blood), balgham (phlegm), sauda (black bile), and safra (yellow bile). By quality and quantity, sickness is defined as an incorrect proportion and uneven distribution, and health is defined as an accurate proportion and mixing of these elements (homeostasis). Therefore, according to this humorous idea, a person will remain healthy as long as their body maintains hemostasis; if this hemostasis is interrupted, a sickness will arise. This is the Unani medical system's law of therapy. Thus, this haemostasis of Akhlat deals with every aspect of disease i.e. etiology, pathology, prevention, and treatment.[24] The Mizaj is among the basics or fundamentals of the Unani system of drugs. For a particular species, the Mizaj is specific, lying in a particular range of maximum- minimal limit within which the Mizaj for all members of that species is confined. The etidal or equilibrium of this distinct Mizaj i.e. conservation of constant internal terrain (homeostasis) in different individualities leads to a healthy body i.e. normal body functions. Any derangement of Mizaj from etadal or imbalance of normal Mizaj results in su-e-mizaj which causes deranged body functions i.e. diseases.[25]

1.1 Need of the study

To develop reference standard norms for RT using the Ruler Drop Method. This study hypothesized significant mizaj differences in RT of RDT performance, and we expected mizaj to somehow influence the RT of participants' performance.

1.2 Clinical significance

RT reference standard norms could act as a benchmark in comparing mizaj among college students of the age group 18-30.

1.3 Objective of the study

RDT involves a specific motor response to a visual stimulus and is an adapted version of the 'ruler drop test' that is used to explain the connections between distance, acceleration and

time for a body falling free under graveness. Unfortunately, Yet, to the best of our knowledge, no norms exist for the ruler drop method to serve as a comparison for reference values of RT in different mizaj among college students age group 18 -30. Therefore, this study aims to establish normative data for mizaj and RT.

2. METHOD AND MATERIALS

This cross-sectional descriptive study was conducted in the Department of Physiology, Ayurvedic and Tibbia College and Hospital, Karol Bagh, Delhi, India from 2020 to 2021. Subjects were given informed consent to go through the details. Before the commencement of the study approval of the Departmental committee was obtained.

2.1 Inclusion criteria

The participants were screened according to the following inclusion criteria: Individuals of 20-60 years of age, Either gender, Participants who fulfil health fitness criteria, participants who were normal, healthy with no background of heavy exercise and athletic exertion were named for study.

2.2 Exclusion criteria

Person aged below 18 years and age above 30 years, Uncooperative students, open wound, recent fracture, contracture or any nerve injury in the upper limb, Alcoholics, Smokers and tobacco users, Pregnancy and lactation, history of trauma, individuals suffering from malnutrition, myopia, diabetes mellitus, hyperthyroidism, hypothyroidism, volunteers with musculoskeletal disability, any type of neuropathy, hearing problem and vision problem which affect on reaction time were excluded from our study.

2.3 Sampling method

Using simple random sampling in Delhi (India) one hundred fifty-five (155) college students from Ayurvedic and Unani Tibbia College and Hospital, Karol Bagh were selected as per inclusion and exclusion criteria and asked to complete the Mizaj questionnaire and after that SRT was checked with the help of Ruler Drop Test(RDT). The data collection process started on 16 August 2021 and ended on 22 December 2021. The participants were adequately informed about all relevant aspects of the survey and each step of the RDT test. All participants voluntarily participated in the survey and the survey was anonymous.

2.4 Research methods

2.4.1 Questionnaire design for determination of mizaj

The assessment of temperament (mizaj) of the volunteers was made on the basis of Ajnas-e-Ashra (ten determinants), i.e. Malmas (Tactus), Lahm-wa-Shahm (Flesh and fats), Ashaar (Hair rate of growth, colour, distribution)), Laun-e-Badan(Body Complexion), Hayyat-e-Aza(Physique), Kaifiat-e-Infaal(Responsiveness of organs), Afal-e-Aza(State of functions)), Fuzlaat-e-Badan(body waste), Nom-wa-Yaqza (sleep and wakefulness), Infalat-e-Nafsaniya (Psychic Reactions) described in Unani classical literature and generated by Central Council for Research in Unani Medicine (CCRUM), Ministry of AYUSH, New Delhi. It comprises questions related to physical characteristics, physiological habits and cerebral makeup of an existent. Each mizaj namely damwi (sanguine), safrawi (bilious), balghami (phlegmatic) and saudawi (melancholic) carries four options. The responses were computed to obtain a final score. Based on responses given by a person in each column of the respective mizaj followed by an interview and physical examination by the researcher, the dominance of a specific mizaj was identified as controlling his or her body anatomically, physiologically and psychologically.

2.4.2 Reaction time assessment

Principle

The neural pathway involved in a response time trial involves a series of neural processes. This trial doesn't test a simple kickback. Rather, this exertion is designed to measure the response time to the commodity that you see. Catching a dropped sovereign begins with the eye watching the sovereign in expectation of it falling. After the sovereign is dropped, the eye sends a communication to the visual cortex, which perceives that the sovereign has fallen. The visual cortex sends a communication to the motor cortex to initiate catching the sovereign. The motor cortex sends communication to the spinal cord, which also sends communication to the muscles in the hand. The final process is the compression of the muscles as the hand grasps the sovereign. All of these processes involve individual neurons that transmit electrochemical messages to other neurons.[26] We found good interrater reliability (0.81) and moderate to good degree of validity (0.5).[18]

Materials used

Metal Ruler of 1-meter length (Camline), Chair and table, Measuring tape (Inditrust), Weighing Machine (WC 150), and Other necessary stationary.

Procedure

All anthropometric measurements will be taken before the initiation of the study.

To measure Reaction time (RT) by ruler drop method (RDM) The participant was invited to sit on a chair with their hand kept in the mid-prone position, elbow flexed to 90 degrees, and forearm supported on a table, with the open hand at the edge of the surface. The ruler will be suspended vertically by the examiner, such that the lower end will be aligned across 5 cm between the web space (i.e. thumb and index finger) of the child's hand. Participants were asked to catch the ruler as quickly as possible, once it was released from the examiner's hand. The ruler was then dropped between two fingers without prior intimation, and the subjects were asked to grasp it as quickly as possible. The research team conducted a demonstration. The participants also performed some familiarization trials for the RDT. The participants were encouraged to reach the best score possible.

The distance the ruler travelled from starting 5 cm will be recorded. Then this distance will be converted into time by using the following formula,

t = 2d / g

Were d is the distance travelled by the ruler g is the gravitational constant (9.8m/s)[27,28]

Outcome measure

Distance(d) in centimetres. The test score was calculated as distance reached, lower distance indicated better performance. Regarding time conversion, the test score was the handling time, with a longer time corresponding to poorer performance.

2.5 Data analysis

Data was analyzed by SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). Tests of normal distribution and homogeneity (Kolmogorov–Smirnov) were conducted on all data before analysis as the sample size of this study is greater than 50. Descriptive statistics were expressed as median and IQR (Interquartile Range), as data did not follow a normal distribution. The reference value of RT also follows the above situation. Significant difference among mizaj was established by Kruskal-Wallis after that an additional post hoc test Dunn's test to compare each group and determine which are significantly different from each other. Significant difference between males and females was established by Mann Whitney U test depending on the normality of collected data. The alpha value was analyzed at the significance of less than 0.05 to minimize type I error.

3. RESULTS

Out of the 155 participants, 77 were female and 78 were male. Safravi mizaj composed the majority of the 50 participants, Balghami mizaj composed of 44, Damvi Mizaj composed of 49, and saudavi composed of 12 participants.

Table 1: Mean Rank of Speed Reaction time in different Mizaj group.

Mizaj	N	Mean rank
Balghami	44	66.66
Damvi	49	80.64
Safravi	50	89.81
Saudavi	12	59.58
Total	155	

Table 2: Median and Interquartile Range of Speed Reaction Time for different mizaj.

Mizaj	Median	Interquartile range
Balghami	.165450	.0713
Damvi	.170000	.0440
Safravi	.188000	.0387
Saudavi	.145000	.1023
Total	.176000	

Table 3: Test Statistics[a,b].

	Speed Reaction Time
Chi-Square	8.470
df	3
Asymp. Sig.	.037
a. Kruskal Wallis Test	
b. Grouping Variable: mizaj	

Table 4: Dunn`s test Pair wise comparison of Mizaj.

Mizaj 1-mizaj 2	Test statistic	Std. Error	Std. Test statistic	Sig.
Saudavi-balghami	7.076	14.610	.484	.628
Saudavi-damvi	21.060	14.449	1.458	.145
Saudavi-safravi	30.227	14.420	2.096	.036
Balghami-damvi	-13.984	9.317	-1.501	.133
Balghami-safravi	-23.151	9.273	-2.497	.013
Damvi-safravi	-9.167	9.018	-1.017	.309

Statistical Decision

H(degree of freedom)= chi-square test statistic, p-value =0.05

H(3)=8.470, p=0.037

Kruskal-Wallis test revealed a statistical difference in mizaj groups across four conditions, chi-square (3, N=155)=8.470,*p*<0.037, and H0 is rejected. As H0 is rejected, it is concluded that the four Mizaj groups do not have the same Speed Reaction Time and at least two groups had a significant difference in Speed Reaction Time. According to Table 2, the Median SRT score was highest in safravi group (*Md=0.1880*) followed by Damvi Mizaj(*Md=0.1700*) in comparison to balghami (*Md=0.16545*) and lowest in saudavi (*Md=0.1450*) group and IQR the was lowest in safravi group(*IQR=0.0387*) followed by Damvi Mizaj(*IQR=0.0440*) in comparison to balghami (*IQR=0.0713*) and highest in saudavi (*IQR=0.1023*) group.

Dunn`s test (Post hoc test) was applied to determine which two groups have significant differences and test results are given in Table 4: As shown in the table safravi vs saudavi and safravi vs balghami showed highest significant mean rank difference (M1 M2) at p< 0.05 with 95% confidence.

4. DISCUSSION

The present study evaluated the response time of participants using the ruler drop test method about different mizaj. After performing the rular drop test results came up in the form of Distance (d) in centimetres which was then converted into response time. The test score indicates running time, a longer time signifies poorer performance. This ruler drop test is a proven suitable method to assess response time and neuromuscular coordination.[29,30]

In previous studies, it is evident that people with high intelligence Time[31,32] and extrovert personality type[33,34,35] have faster reaction times. According to Unani medicine sources, it is evident that fast reaction time depends on af'aal nafsania (Psychic functions) and mental alertness which are high in high-energy, extrovert and higher intelligence people which are safravi due to their hot and dry mizaj followed by damvi which have hot and moist mizaj while low in low energy and introvert composed of balghmi which have cold and moist mizaj while followed by saudavi which have cold and dry mizaj.[36] Thus, this is in line with the results of our study results demonstrated a correlation between the hotness and coldness of mizaj and SRT which showed that speed reaction time is higher in safravi and damvi people followed by balghami and least in saudavi mizaj.

According to Unani scholars, the Quickness of the body reacting to a certain state is the evidence of preponderance of heat state in the body[37] and quality of reaction is the quantity of the body being affected quickly or slowly by four-fold states of hotness, coldness,

moistness or dryness. Thus, safravi mizaj is more hyper-reactive hot and dry state followed by damvi due to hot and moist state while balghami mizaj is sluggishly reactive to cold and moist mizaj followed by saudavi mizaj cold and dry and least in reaction.[38] This is to the results of our study with the highest reaction time in safravi followed by damvi than balghami and lowest in saudavi mizaj.

Reaction time is one of the important methods to study a person's central information processing speed and coordinated peripheral movement response.[39] Unani scholars considered that individuals having Haar Mizaj (Safrawi and Damvi) would have faster motor functions as compared to individuals having Baarid Mizaj (Balghami and Saudawi).[40] Kabeeruddin stated in his book Al Akseer that, In healthy individuals, hyperactivity and increase responsiveness in motor functions are indicative of Haar Yabis Mizaj of brain while hypo activity and decrease responsiveness are indicative of Baarid Ratab Mizaj of brain.[41] S.I. Ahmed in the book Kulliyat-e-Asri states person with a hot temperament has hyperactive motor functions and a cold temperament indicates sluggish motor functions.[41] The experiment results provide a clear insight into the relationship between central information processing speed and coordinated peripheral movement response by influencing motor nerve conduction velocity in maintaining faster motor functions in haar mizaj and slow motor functions in barid mizaj as the results of our study with highest reaction time in haar i.e safravi followed by damvi than barid i.e. balghami and lowest in saudavi mizaj.

According to Ibn Sina, the motor response/movements will not be the same in every person. 'Excess heat is displayed when functions occur quickly, such as the quick movements of organs, the quick growth of hair, and the quick eruption of teeth. The functions signify coldness if they are sluggish, feeble, dull, or inactive. A few strong indicators of hotness are having a loud, strong voice, speaking quickly and continuously, having a short fuse, moving quickly, and blinking frequently. These results should be taken into account when considering this theory.

Unfortunately, variables such as socio-demographics, IQ, and participants' behaviour were not assessed in this study which could have provided a better interpretation of reaction time scores. Another limitation of the study was that we failed to maintain a minimum sample size of 50 children in each mizaj group. Nevertheless, the study emphasizes the importance of using a simple reaction time task, the ruler drop method, as an assessment tool in young college students, and provides the stakeholders with normative data to be used as reference.

To overcome these shortcomings, future research should be designed with a sufficient sample size and take into account the other factors listed above.

Conflicts of interest

None that the writers are aware of exist.

Limitations

Lack of detailed demographic information may restrict applicability to diverse populations. Strict exclusion criteria may limit the study's relevance to individuals with specific conditions. Ruler Drop Method (RDM) limitations compared to computerized assessments were not addressed. Lack of assessment for additional psychological variables that could influence reaction time.

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