Research Article

Investigating the Correlation Between Agility and Jump Performance Indices in Indian Contact Sports Persons: An Observational Study

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ABSTRACT

Introduction: The use of the jump as a plyometric exercise is a way to improve jump performance. Additionally, as it requires abrupt stopping, starting, and changing directions, it might enhance agility. Thus, this study aims to find out the relationship between drop jump variables and agility in contact sports.

Materials and Methods: A total of 30 national-level male athletes (age=20.06±1.94 years; height=1.67±0.06 m; body weight: 58.02±8.40 kg) participated in this study. A drop jump test was performed on the Kistler force plate and agility was assessed by using the Illinois agility test along with the agility t-test. The Pearson correlation test was used to find the significant relationship between agility tests completion time and jump height from flight time, reactive strength index, average power, average force, and contact time for drop jumps.

Results: The results indicate a significant moderate negative correlation between jump height from flight time and agility test time (r=-0.501 with Illinois agility test, P=0.005, and r=-0.601 with agility t-test, P=0.001). A significant weak negative correlation was observed between average power and Illinois agility test time (r=-0.477, P=0.008).

Conclusion: These findings indicate that improved drop jumps will interpret better agility movements or vice versa; therefore, individuals who perform sports that require agile movement benefit from agility assessment and drop jump training.

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1. Introduction

Agility is defined as a combination of braking, changing direction, and accelerating in a vertical or horizontal direction while retaining motor control in response to a stimulus [1]. Agility is an important component in sports, such as soccer, basketball, football, and hockey, where the ability to change directions is emphasized [2]. Research suggests that agility is a reliable indicator of total sports success [3]. The need to improve agility and performance markers connected to agility has attracted significant interest in strengthening and conditioning professionals due to the direct execution of agility in sports performance [2].

Jumping is a fundamental characteristic that is required in a variety of sports [4]. The vertical drop jump test is a lower-leg eccentric-concentric power test. The stretch-shortening cycle (SSC) is a kind of activity in which the muscle is stretched immediately before being explosively contracted to produce high levels of force and power [5]. A drop jump is when a person drops from a certain height and quickly performs a rebound vertical leap [6]. Furthermore, a drop jump is a type of plyometric activity that entails explosive stopping, starting, and changing directions that could help the individual develop agility [7].

Jump height (JH) is an essential factor in sports, such as basketball and volleyball that require explosive lower-body force [8]. The reactive strength index (RSI) can also be measured with a drop jump [8]. The capacity to rapidly switch from eccentric to concentric muscular activity is measured using the RSI, which is computed by dividing jump height by ground contact time (GCT) [8]. Muscle power is considered the most important component in all sports, particularly in team sports, and involves the influence of rapid and short-duration muscular action on an athlete's fitness and skills [9].

Studies have shown that the drop jump test is significantly related to both straight sprinting speed and change of direction speed, showing a correlation. This is because the pushing-off actions are similar. However, there is less evidence directly related to agility performance [10]. According to other research, speed, agility, and leaping ability are influenced by the same physiological and biomechanical factors [11]. The vertical jump test is used by coaches, athletic trainers, and physical therapists to assess an athlete's physical capacity, quantify the effectiveness of a training program, and identify an athlete's fitness to return to sport after an injury [12].

Agility involves movements that produce a variety of vertical, horizontal, and lateral ground reaction impacts, as well as strong stretch-shortening cycle loads [13]. Furthermore, drop jumps also incorporate high stretch-shorten cycle loads [14]. Considering the complexity of the movements of agility and drop jump, these movements may provide a more reliable option for studying the nature of any connection between drop jumps and agility [13]. There is little research on the relationship between the various variables of the drop jump and agility and how they contribute to variability in agility performance in contact sports. Accordingly, this study aims to observe the association between drop jump's various parameters and agility among players.

2. Materials and Methods

Study design

This was an observational study. Athletes were recruited from the Guru Nanak Dev University, Amritsar Punjab, India, and research was conducted from September 2021 to February 2022. A total of 30 national-level athletes from contact sports (football and handball) with an age range of 20.06±1.94 years, height of 1.67±0.06 m, and weight of 58.02±8.40 kg participated in this study. The inclusion criteria were participants in the age range of 18 to 25 years being free from injury for the last 3 months. Furthermore, athletes were currently involved in regular exercise and sports. A priori power analysis was conducted using the G*Power software, version 3.1 (Universität Kiel, Germany). A total of 29 subjects were needed to find a correlation with power (1-β) set at 0.80 and α=0.05.

Measurement tools

Quattro Jump, Kistler, model 9290DD, Winterthur, Switzerland was used to assess the drop jump variables. The field-based Illinois agility test and the agility t-test were used to assess agility, consisting of cones, measuring tape, and a stopwatch.

Study procedure

The outcome variables were measured during 2 separate sessions. During session 1, anthropometric data (age, height, weight) was obtained and athletes performed drop jumps (total of 3 jumps). The second session required athletes to complete 2 agility tests (3 trials per agility test; a total of 6 trials). Sessions were completed on non-consecutive days with 24 h intervals to ensure a full recovery.

Figure 1. Represents the weight measurement on Kistler force plate

Anthropometric data

Athletes' height was measured using a stadiometer. Also, the body weight was measured on Quattro Jump, Kistler, model 9290DD, Winterthur, Switzerland (Figure 1). During the height and weight measurements, the athlete was instructed to remove their shoes and stand with their back straight and head in a neutral position. The height was measured in meters and weight in kg as mentioned in Figure 1.

Jumping test

Before the jump testing, the subjects completed a 5-min warm-up on a Monark 874E cycle ergometer (Monark Exercise AB, Vansbro, Sweden) at a self-selected pace along

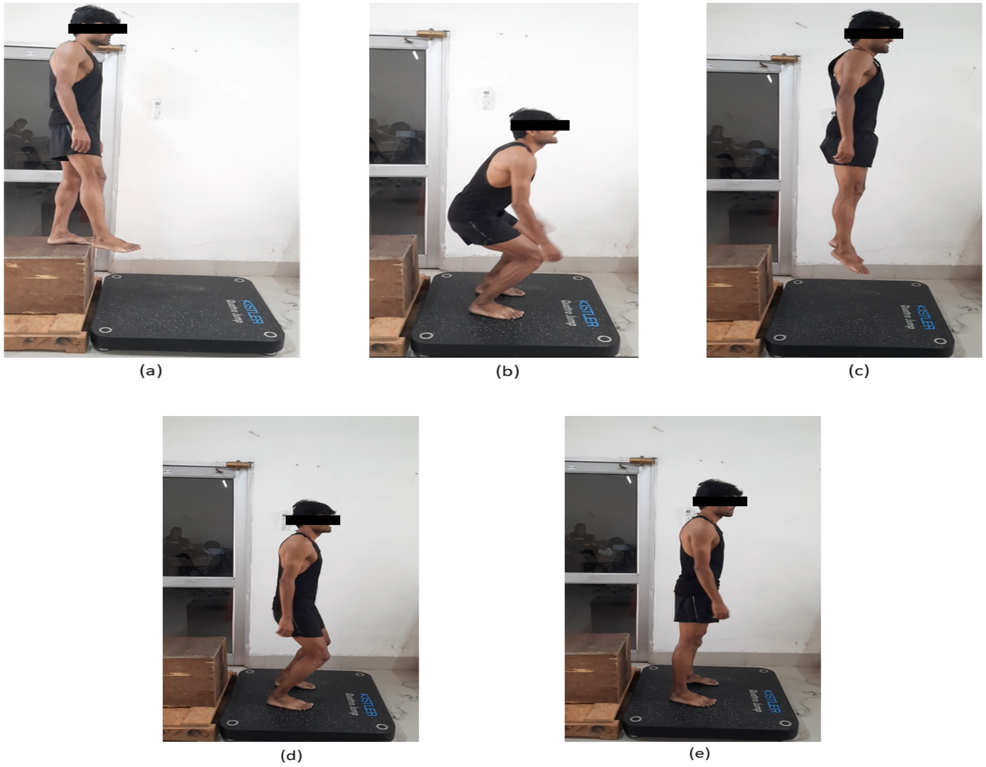

Figure 2. The procedure of performing a drop jump on the Kistler force plate

A) Initial stance, B) Initial contact and peak flexion, C) Vertical jump, D) Initial landing, E) Final landing with a series of dynamic drills (walking knees to chest, lunge walks, high knee, butt kicks, and body weight squats) [15]. Afterward, athletes were given a 2-min rest. Then, the athletes were asked to perform 3 submaximal drop jumps at the drop height of 40 cm for warm-up jumps with 30 s rest between each jump. Then, the athletes performed 3 maximal bilateral drop jumps on the force plate (Quattro Jump, Kistler, model 9290DD, Winterthur, Switzerland). The athletes performed drop jumps with arm swings at a drop height of 40 cm by stepping off the box with their right leg and immediately performing a maximal rebound vertical jump upon landing on the force plate (Figure 2). Each athlete performed 3 maximal drop jumps in total. The best of the 3 jumps was recorded [16]. The variables of interest were jump height from flight time, RSI, average power, average force, and contact time.

Agility testing

The Illinois agility test and the agility t-test were used to determine agility [17]. The Illinois agility test was used to measure the individual's ability to accelerate, decelerate, turn in various directions, and run at various angles. The athletes' times were taken to the closest 0.01 s using a handheld stopwatch. On the signal "go," individuals ran 10 m, turned, and returned to the starting line. When the athletes arrived at the starting line, they zigzagged between 4 markers before sprinting 2 times for a total of 10 m. The final agility time was based on the quickest time of the 3 trials. Between each trial, a 5-min break was given [18]. The agility t-test was developed to assess speed with directional changes, such as sprinting straight, shuffling left and right, and running backward. The athletes were told to run from a standing start to a cone 10 m away, then shuffle left to a cone 5 m away. The athletes' side shuffled to the 10 m distant cone after touching the cone and then returning to the center cone. Backward running to the starting line was used to finish the test. The best time of the 3 attempts was recorded to the closest 0.01 s as the test score. Between each trial, a 5-min break was given. Failure to touch the base of any cone, cross one foot in front of the other, or face forward for the duration of the test resulted in disqualification [18].

Statistical analysis

The outcomes were analyzed for the normal distribution using the Shapiro-Wilk test. The statistical analysis was performed using SPSS software, version 26. The statistical significance was defined at the 5% ($P \leq 0.05$) level. The Pearson correlation test was used for the correlational analysis. The drop jumps' height from flight time, RSI, average power, average force, contact time, Illinois agility test, and agility t-test values was used to find the correlation. The evaluation of relationships was performed according to Mukaka [19], based on the absolute values of correlation coefficients [20].

3. Results

Descriptive data of all the variables taken in the study are provided in Table 1. A significantly moderate negative correlation was reported between jump height from flight time and the Illinois agility test (r=-0.501, P=0.005) (Table 2). Similarly, a significantly moderate negative correlation was also reported between jump height from flight time and agility t-test (r=-0.601, P=0.001) (Table 2). A low significant negative correlation was reported for average power with the Illinois agility test (r=-0.477, P=0.008); however, it non-significantly correlated with t-test timing (Table 2).

4. Discussion

This research was conducted aiming to identify the relationship between jump performance and agility in contact sports. We hypothesized a correlation between drop jump variables and agility. The two variables from our study were correlated with the agility test timings; that is, jump height from flight time and average power, whereas other variables were found statistically non-significant.

One of the important findings of the present study is that there is a significant moderate negative correlation between jump height from flight time and agility tests completion timings (r=-0.501, P=0.005 with Illinois agility test; r=-0.601, P=0.001 with t-test). Several studies were in line with our result in terms of finding the association between countermovement jump height and linear sprinting stronger with longer distances compared to shorter distances [21]. Another study found moderate to substantial relationships between young basketball players' jumping ability and agility performance suggesting that jump exercises and agility should be considered in conditioning and may be used for maximal force mobilization [11]. Another study observed strong correlations between countermovement jump and zigzag agility test with and without the ball in soccer players, concluding that agility and jump performance share common physiological and biomechanical determinants [22]. Adding to the current study's findings, another study discovered a substantial negative connection between agility t-test and jump test performance in elite male basketball players suggesting that agility should be considered a physiological skill in players [23]. Moreover, another study revealed a substantial negative association between countermovement jump and agility T-test in professional basketball male players [24].

Table 1. Descriptive data of all variables

Variables	Mean±SD
Age (y)	20.06±1.94
Height (m)	1.67±0.06
Weight (kg)	58.02±8.40
Jump height from flight time (m)	0.31±0.04
Reactive strength index	1.20±0.24
Average power (kW)	2.23±0.47
Average force (kN)	1.53±0.37
Contact time (s)	0.40±0.23
Illinois agility test (s)	16.78±0.57
Agility t-test (s)	10.10±0.87

Values are presented as Mean±Standard deviation.

JMR

Table 2. Correlation between drop jump variables and agility tests

Variables		Illinois Agility Test (s)	Agility T-test (s)
Jump height from flight time (m)	r	-0.501**	-0.601**
	P	0.005	0.001
RSI	r	-0.202	-0.154
	P	0.285	0.416
Average power (kW)	r	-0.477**	-0.339
	P	0.008	0.067
Average force (kN)	r	-0.306	-0.121
	P	0.1	0.524
Contact time (s)	r	-0.004	-0.166
	P	0.983	0.379
Illinois agility test (s)	r	1	0.903**
	P		0.001
Agility t-test (s)	r	0.903**	1
	P	0.001	

JMR

RSI: Reactive strength index.

r: Pearson correlation; r=0.90–1.00: Very high; r=0.70–0.89: High; r=0.50–0.69: Moderate; r=0.30–0.49: Low; 0.00–0.29=Negligible. **Statistically significant associations at P≤0.05.

There are positive benefits of jump training on agility performance [18]. Agility is a multifaceted physical talent influenced by strength, speed, balance, flexibility, and muscle coordination [23]. Rapid force development and high-power output are required for agility improvement; accordingly, jump training will help fulfill these demands [25]. Jumping has also improved the eccentric strength of the thigh muscles, which is important during the deceleration stage of a change of direction [14]. Improvements in agility tests can also be attributed to neural alterations and enhanced motor unit activation [25]. For agility tasks, a rapid shift from eccentric to concentric muscular activity in the leg extensor muscles is also needed (the short stretching cycle muscle function). The short stretching cycle muscle function exercise can improve agility performance by increasing muscular power production and movement efficiency [26].

According to our findings, the average power has a significant inverse association with the Illinois agility test (r=-0.477, P=0.008). Lower body power, as evaluated by the bilateral counter movement leap was substantially connected with both the pro agility test and the Illinois agility test in female high school and collegiate soccer players [21]. The requirement of rapidly building forces in a short amount of time to push the body in a specific direction clarifies the connections between power and agility completion time [2]. Furthermore, larger levels of acceleration and faster completion times of ground-based activities, such as sprinting over relatively short distances have been linked to a stronger capacity to create muscle power [27]. As a result, athletes improved muscle power capacity has led to increased levels of acceleration, allowing them to finish the agility test faster. Maximal jumping is widely recognized as a dynamic action needing high muscular strength and because agility performance is also a dynamic movement demanding high muscle power, jumping and agility performances are closely associated [28].

On the other hand, RSI, average force, and contact time were found to be insignificant. In contrast to this, another study found that the ratio between jump height and contact time, and agility had significant and extremely high correlations, suggesting that this strength attribute is crucial for agility performance [29]. A low association between RSI and agility was observed in other studies [30]. The disparity might be explained by the various agility tests employed.

5. Conclusion

The findings of this study suggest that a low to moderate negative association exists between certain drop jump variables and agility. Agility movement displayed a moderate negative association with drop jumps' height suggesting that improved bilateral drop jumps will interpret better agility movements. Hence, sports activities requiring agility movement may benefit from the assessment of agility and jump training. Moreover, average power association during jumping was observed with agility. Consequently, agility performance is a multifaceted ability. These relationships suggest that training aimed to develop the leg muscular power could be emphasized for agility development training as a specific motor task. However, coaches and individuals desire to focus on muscular power since the stretch-shortening cycle and rate of force development necessary for improved jumping are the mechanisms behind the associations observed with agility.

Study limitations

The small sample size of our study was a limitation of the study. The use of correlation analysis is another weakness of the current study. Correlations do not prove causation, but they show that 2 variables are linked within these constraints. The current findings emphasize the necessity for a full battery of field testing to assess athlete performance.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Institutional Ethics Committee of Guru Nanak Dev University (Code: 752/HG, dated 2021/09/28). Informed consent was obtained from each participant before data collection.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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References

[1] Hachana Y, Chaabène H, Nabli MA, Attia A, Moualhi J, Farhat N, et al. Test-retest reliability, criterion-related validity, and minimal detectable change of the Illinois agility test in male team sport athletes. The Journal of Strength & Conditioning Research. 2013; 27(10):2752-9. [DOI:10.1519/JSC.0b013e3182890ac3] [PMID]

[2] Dietze-Hermosa M, Montalvo S, Cubillos N, Gonzalez M, Dorgo S. Association and predictive abilityof vertical countermovement jump performance on unilateral agility in recreationally trained individuals.Journal of Physical Education and Sport. 2020; 20:2076-85. [Link]

[3] Garcia-Gil M, Torres-Unda J, Esain I, Duñabeitia I, Gil SM, Gil J, et al. Anthropometric parameters, age, and agility as performance predictors in elite female basketball Players. Journal of Strength and Conditioning Research. 2018; 32(6):1723-30. [DOI:10.1519/JSC.0000000000002043] [PMID]

[4] Requena B, Garcia I, Requena F, Bressel E, Saez-Saez de Villarreal E, Cronin J. Association between traditional standing vertical jumps and a soccer-specific vertical jump. European Journal of Sport Science. 2014; 14(sup1):S398-405. [DOI:10.1080/17461391.2012.708790] [PMID]

[5] Wang IL, Chen YM, Zhang KK, Li YG, Su Y, Wu C, et al. Influences of different drop height training on lower extremity kinematics and stiffness during repetitive drop jump. Applied Bionics and Biomechanics. 2021; 2021:e5551199. [DOI:10.1155/2021/5551199] [PMID] [PMCID]

[6] Byrne PJ, Moran K, Rankin P, Kinsella S. A comparison of methods used to identify 'optimal' drop height for early phase adaptations in depth jump training. The Journal of Strength & Conditioning Research. 2010; 24(8):2050-5. [DOI:10.1519/JSC.0b013e3181d8eb03] [PMID]

[7] Meylan C, McMaster T, Cronin J, Mohammad NI, Rogers C, Deklerk M. Single-Leg lateral, horizontal, and vertical jump assessment: Reliability, interrelationships, and ability to predict sprint and change-of-direction performance. The Journal of Strength & Conditioning Research. 2009; 23(4):1140-7. [DOI:10.1519/JSC.0b013e318190f9c2] [PMID]

[8] Flanagan EP, Comyns TM. The use of contact time and the reactive strength index to optimize fast stretch-shortening cycle training. Strength & Conditioning Journal. 2008; 30(5):32-8. [DOI:10.1519/SSC.0b013e318187e25b]

[9] Hamsa H, Khan M, Tanwar T, Irshad N, Numani S. Acute effects of weighted plyometric exercise on sprint, agility and jump performance in university football players. Physical Activity Review. 2021; 9(1):1-8. [DOI:10.16926/par.2021.09.01]

[10] Barnes JL, Schilling BK, Falvo MJ, Weiss LW, Creasy AK, Fry AC. Relationship of jumping and agility performance in female volleyball athletes. Journal of Strength and Conditioning Research. 2007; 21(4):1192-6. [PMID]

[11] Asadi A. Relationship between jumping ability, agility and sprint performance of elite young basketball players: A field-test approach. Revista Brasileira de Cineantropometria & Desempenho Humano. 2016; 18:177-86. [DOI:10.5007/1980-0037.2016v18n2p177]

[12] Davis DS, Briscoe DA, Markowski CT, Saville SE, Taylor CJ. Physical characteristics that predict vertical jump performance in recreational male athletes. Physical Therapy in Sport. 2003; 4(4):167-74. [DOI:10.1016/S1466-853X(03)00037-3]

[13] Henry GJ, Dawson B, Lay BS, Young WB. Relationships between reactive agility movement time and unilateral vertical, horizontal, and lateral jumps. Journal of Strength and Conditioning Research. 2016; 30(9):2514-21. [DOI:10.1519/JSC.0b013e3182a20ebc] [PMID]

[14] Sheppard JM, Young WB. Agility literature review: Classifications, training and testing. Journal of Sports Sciences. 2006; 24(9):919-32. [DOI:10.1080/02640410500457109] [PMID]

[15] Miller MG, Herniman JJ, Ricard MD, Cheatham CC, Michael TJ. The effects of a 6-week plyometric training program on agility. Journal of Sports Science & Medicine. 2006; 5(3):459-65. [PMID]

[16] Addie CD, Arnett JE, Neltner TJ, Straughn MK, Greska EK, Cosio-Lima L, et al. Effects of drop height on drop jump performance. International Journal of Kinesiology and Sports Science. 2019; 7(4):28-32. [Link]

[17] Mackenzie B. Performance evaluation tests. London: Electric World plc; 2005. [Link]

[18] Asadi A. Effects of six weeks depth jump and countermovement jump training on agility performance. Sport Science. 2012; 5(1):67-70. [Link]

[19] Mukaka MM. A guide to appropriate use of correlation coefficient in medical research. Malawi Medical Journal. 2012; 24(3):69-71. [Link]

[20] Gillen ZM, Shoemaker ME, McKay BD, Bohannon NA, Gibson SM, Cramer JT. Leg extension strength, explosive strength, muscle activation, and growth as predictors of vertical jump performance in youth athletes. Journal of Science in Sport and Exercise. 2020; 2(4):336-48. [DOI:10.1007/s42978-020-00067-0]

[21] Vescovi JD, Mcguigan MR. Relationships between sprinting, agility, and jump ability in female athletes. Journal of Sports Sciences. 2008; 26(1):97-107. [DOI:10.1080/02640410701348644] [PMID]

[22] Köklü Y, Alemdaroğlu U, Özkan A, Koz M, Ersöz G. The relationship between sprint ability, agility and vertical jump performance in young soccer players. Science & Sports. 2015; 30(1):e1-5. [DOI:10.1016/j.scispo.2013.04.006]

[23] Alemdaroğlu U. The relationship between muscle strength, anaerobic performance, agility, sprint ability and vertical jump performance in professional basketball players. Journal of Human Kinetics. 2012; 31:149-58. [DOI:10.2478/v10078-012-0016-6] [PMID] [PMCID]

[24] Chaouachi A, Brughelli M, Chamari K, Levin GT, Ben Abdelkrim N, Laurencelle L, et al. Lower limb maximal dynamic strength and agility determinants in elite basketball players. Journal of Strength and Conditioning Research. 2009; 23(5):1570-7. [DOI:10.1519/JSC.0b013e3181a4e7f0] [PMID]

[25] Thomas K, French D, Hayes PR. The effect of two plyometric training techniques on muscular power and agility in youth soccer players. Journal of Strength and Conditioning Research. 2009; 23(1):332-5. [DOI:10.1519/JSC.0b013e318183a01a] [PMID]

[26] Markovic G, Mikulic P. Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. Sports Medicine. 2010; 40(10):859-95. [DOI:10.2165/11318370-000000000-00000] [PMID]

[27] Morin JB, Bourdin M, Edouard P, Peyrot N, Samozino P, Lacour JR. Mechanical determinants of 100-m sprint running performance. European Journal of Applied Physiology. 2012; 112(11):3921-30. [DOI:10.1007/s00421-012-2379-8] [PMID]

[28] Fatih H. The relationship of jumping and agility performance in children. Ovidius University Anals, Series Physical Education and Sport/Science, Movement and Health. 2009; 9(2):140-2. [Link]

[29] Young WB, Murray MP. Reliability of a field test of defending and attacking agility in Australian football and relationships to reactive strength. The Journal of Strength & Conditioning Research. 2017; 31(2):509-16. [DOI:10.1519/JSC.0000000000001498] [PMID]

[30] Young WB, Miller IR, Talpey SW. Physical qualities predict change-of-direction speed but not defensive agility in Australian rules football. The Journal of Strength & Conditioning Research. 2015; 29(1):206-12. [DOI:10.1519/JSC.0000000000000614] [PMID]