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Research Paper

Unveiling the Relationship Between Gait Patterns and Personality Traits in Transgender Populations

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ABSTRACT

This study examines the comparison between transgender individuals gait measurements and personality variables to evaluate their potential usefulness of forensic importance in sex determination. Footprint measurements like stride length, step length, foot length, and foot angles were used to examine the gait patterns of sixty participants which included (30 trans men and 30 trans women) from Samara and Sangama organisation, Bengaluru. Personality characteristics in Transgender individuals were profiled using the Big Five Personality Inventory (BFI). The findings revealed notable differences between transgender groups: - Gait Patterns: in trans men (60.20°) showed significantly greater foot angles compared to trans women (46.76°), between the first and second steps. Transwomen exhibited longer average foot length compared to transmen. The Personality traits indicated, that there was a significant difference in the parameters between trans men and trans women in extraversion. Whereas, transmen are more extroverted and transwomen are less extroverted. Also, in openness to experience personality trait Transmen had high openness to experience than transwomen. Neither gait characteristics nor personality characteristics alone were sufficient for inferring sex determination among transgender samples. The combination of gait and personality place a very vital role in the forensic field especially when biological samples were limited, unavailable or degraded. This study emphasizes how crucial the reflection of forensic applications plays an important role in the study of personality factors and gait patterns which would target underrepresented populations like transgender. In this research study, it is essential to prioritize on ethical issues, inclusion, and informed consent.

Keywords: *Gait pattern analysis, Personality traits, Transgender, Biomechanics, Ethical considerations, sex determination*

Forensic podiatry is still a new specialization of forensic science. In this specialty, foot shape and gait analyses are applied to a variety of criminal investigations. Gait is defined as the manner an individual walks and can be considered a dynamic, behavioral biometric information that is personal and discriminating because it is difficult to camouflage. Wearing different shoes, or even walking in a few different styles, will impact

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the way that a person walks, but a gait cannot be 'hidden' like a fingerprint can be. Gait is considered a behavioral biometric as it can be viewed from a distance using closed circuit television (CCTV), impressions left by footprints or other sequential tracks at or near the crime scene. Gait has been used in several or has been employed in several investigations including homicide, robbery, sexual assault, or hit-and-run, etc., where biological material (DNA, blood) was not present, or if biological material encountered was limited due to contamination **(Krishan et al., 2015) (Baryah et al., 2019)**

Within forensic science literature, sexual dimorphisms indicate a dynamic relationship with gait when examining sex (gender). The literature indicates that cisgender men will normally display longer stride length, less pelvic sway, and change vertical displacement and the center of gravity changes while walking (generally get taller), compared to cisgender women where they are usually seen to display shorter stride length, wider angles of pelvic rotation, and increase foot angles (**Nagare et al., 2018) (Boonstra et al., 2008)**. All of these features about an individual's gait provides demographic information for Identification, when there is absent biological sample, or the sample has no ability to contribute to identification or are in degraded condition. Still, there is limited literature on transgender gait. In essence, gender confirming interventions are biomechanics. Transgender women using estrogen therapy may have more pelvic motion and shorter strides, but transgender men taking testosterone therapy are likely to have longer strides, harder heel strikes and less pelvic swing **(Wierckx et al., 2014) (Wiik et al., 2019).** Persons who are mid-transition have a mixed gait which makes strict categorization difficult **(Ford et al., 2022).** These significant differences have implications in forensic contexts and underscore the importance of studying transgender groups.

The personality traits and Gait pattern can be correlated in various ways. The Big Five model indicates that extraversion, conscientiousness, and neuroticism influence stride length, ease of cadence, and posture **(Adlou et al., 2025).** Some studies emphasize that evidence suggests a combination of psychological profiling and gait analysis can expand forensic work, or profiles that can provide behavioural as well as biomechanical identifier.
The current work closes this gap by analysing the gait measurements and personality traits of transgender individuals, evaluating their combined forensic relevance, and promoting diversity in forensic research.

METHODOLOGY

Participants

This study comprised of 60 transgender individuals, 30 were transwomen and 30 were transmen. Participants were selected based on the convenience from Samara organisation in Bengaluru. Participants were selected based on their willingness to participate and ethical approval was obtained. Prior to data collection informed consent was taken from participants.

Tools employed

With the guidance of expert, the researcher used two primary measures. For gait analysis, a protractor and a 60 cm wooden scale were used to measure linear parameters (strid length, step length, foot lengths) **Patil (2021)** and angular parameters (foot angles) **DFSL Manual, Mumbai** measured according to standardized anthropometric protocols. The psychological features of the subjects were categorized with the Big Five Personality Inventory, the BFI assesses five different personality characteristics: openness to experience, conscientiousness,

extraversion, agreeableness and emotional stability **Gumban, R. J. (2024, July 15**). Both measures were chosen based their reliability and validity in both forensic and behavioural studies.

Procedure

The authors went to the participant groups personally. After ethical consent was acquired by the Institution and the participant, a brief introduction was given about the project and demographic information about participants was collected. Instructions were given to participants to walk naturally across the catering paper while eventually recording gait parameters. The 60 cm wooden scale was used for stride length and step length, and the protractor was used to record foot angles. Each sample measurement was taken utmost precision and accuracy.

The Big Five Personality Inventory was then administered. Participants answered the questionnaire in their native language they chose (Kannada, English, Tamil), with clarifications provided when needed to aid comprehension. Data was collected with confidentiality observed.

After the data collection process was completed, gait and personality were scored according to the standard conventions for scoring the Big Five Inventory. Descriptive and inferential statistical methods were used to examine group differences between trans men and trans women.

RESULTS

Table 1 Mean Height, Weight and Age of Transgender individual and Results of Independent Samples T-Test

VARIABLES	GENDER	MEAN	Std. Deviation	't value'	'p value'
HEIGHT (cm)	Transwomen	168.7667	14.34473	.162	.872
	Transmen	168.2000	12.73984		
WEIGHT (kg)	Transwomen	15.28379	15.28379	-.792	.432
	Transmen	11.93515	11.93515		
AGE (yrs)	Transwomen	9.19951	9.19951	-1.184	.241
	Transmen	7.74752	7.74752		

There were no statistically significant differences between transmen and transwomen when the demographic variables of height, weight, and age were compared. In terms of height, transmen's mean score (168.2000) was lower than transwomen's (168.7667); $t = 0.162$, $p = 0.872$. The mean weight for transmen was lower (11.93515) than transwomen (15.28379) ($t = -0.792$, $p = 0.432$). The mean age for transwomen was higher (9.19951) than transmen (7.74752) ($t = -1.184$, $p = 0.241$). They were not statistically significant differences in these demographic parameters, that is all p-values > 0.05, This implies that the sample's transmen and transwomen are largely similar in terms of age, height, and weight.

Table 2 Mean values for all the Gait Parameters result of Independent Samples T-Test

VARIABLES	GENDER	MEAN	Std. Deviation	't value'	'p value'
Second Foot Angles	Transwomen	14.6000	6.07198	-1.433	.157
	Transmen	16.9333	6.53338		
Foot Angle Between 1st And 2nd Foot	Transwomen	46.7667	14.76875	-3.569	.001
	Transmen	60.2000	14.38246		
Foot Angle Between 2nd And 3rd Foot	Transwomen	43.2333	14.92206	-2.516	.015
	Transmen	52.3000	12.92191		
Foot Angle Between 3rd And 4th Foot	Transwomen	44.4000	20.46460	-1.479	.145
	Transmen	50.9333	12.92134		
Foot Angle Between 4th And 5th Foot	Transwomen	55.5667	17.08333	-1.036	.305
	Transmen	60.8000	21.76425		
Left Stride Length	Transwomen	85.3267	11.78640	1.390	.170
	Transmen	80.9567	12.55901		
Right Stride Length	Transwomen	83.0600	11.51046	.660	.512
	Transmen	80.7367	15.47638		
Left Step Length	Transwomen	43.3800	8.36035	.054	.957
	Transmen	43.2467	10.49981		
Right Step Length	Transwomen	39.7333	8.31755	-.290	.773
	Transmen	40.4267	10.13427		
Average Foot Length	Transwomen	24.9967	1.68921	3.317	.002
	Transmen	23.8433	.87992		
2nd Foot Angle	Transwomen	13.6333	4.48356	-1.900	.062
	Transmen	16.0333	5.26854		
3rd Foot Angle	Transwomen	13.5667	4.93183	.327	.745
	Transmen	13.2000	3.65211		
4th Foot Angle	Transwomen	12.8000	4.08867	-.834	.408
	Transmen	13.6667	3.95957		
5th Foot Angle	Transwomen	14.5333	6.58490	-.263	.793
	Transmen	14.9667	6.16712		
Principal Angle between 2nd And 3rd Foot	Transwomen	29.3333	7.21748	-4.986	.001
	Transmen	39.0000	7.79036		

Overall, there was significant difference in the three variables between the transgender groups. Higher angular values were found in trans males, particularly in the primary angle between the second and third feet (p =.001) and the foot angle between the first and second feet (p =.001). Trans women, had a longer average foot length (p =.002). According to these findings, the most accurate ways to distinguish between distinct gait profiles are through angular metrics and foot length. On the other hand, there was no significant difference in stride length, step length, or foot angles (2nd–3rd, 3rd–4th, and 4th–5th). Although trans men often had larger mean foot angles and trans women somewhat longer strides, these differences were not statistically significant.

Table 3 Significance of Extraversion personality trait in relation to gender

EXTRAVERSION		GENDER		TOTAL
		TRANSMEN	TRANSWOMEN	
LOW	FREQUENCY	10	21	31
	PERCENT	33.3%	70.0%	51.7%
HIGH	FREQUENCY	20	9	29
	PERCENT	66.7%	30.0%	48.3%
TOTAL	FREQUENCY	30	30	60
	PERCENT	100.0%	100.0%	100.0%
TEST STATISTIC		$X^2(A) = 8.076$ p = .004		

Transwomen (70.0%) reported lower levels of Extraversion compared to transmen (33.3%), and transmen (66.7%) reported higher levels of Extraversion compared to transwomen (30.0%). The varying distributions provide evidence for a relative difference in identifying the personality trait Extraversion between the transwomen and transmen gender groups. The chi square analysis results (X2(A) = 8.076 p = .004) showed significant relation between gender identity and levels of Extraversion, which indicates that transwomen are generally less extroverted while transmen are more extroverted.

Table 4 Significance of Openness to Experience personality trait in relation to gender

OPENNESS TO EXPERIENCE		GENDER		TOTAL
		TRANSMEN	TRANSWOMEN	
LOW	FREQUENCY	13	24	37
	PERCENT	43.3%	80.0%	61.7%
HIGH	FREQUENCY	17	6	23
	PERCENT	56.7%	20.0%	38.3%
TOTAL	FREQUENCY	30	30	60
	PERCENT	100.0%	100.0%	100.0%
TEST STATISTIC		$X^2(A) = 8.531$ p = .003		

A higher percentage of transwomen (80.0%) were less open to experience than transmen (43.3%). Conversely, a higher percentage of transmen (56.7%) were open to experience. This evidence suggests that the samples have an important distinction when looking at openness. The Chi-square test ($X^2 = 8.531$, p = .003) found a statistical association between gender identity and openness to experience in our sample. Transmen have high openness to experience than transwomen

Table 5 Two–Way Annova Analysis of Gait Variables W.R.T Gender, Extraversion Personality Trait and Interaction between Gender and Extraversion.

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
SECOND FOOT ANGLE	Transmen	LOW	15.5000	5.23344	F=.548 P=.462	F=2.563 P=.115	F=.135 P=.715
		HIGH	17.6500	7.11022			
		TOTAL	16.9333	6.53338			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
	Transwomen	LOW	13.5714	3.98210			
		HIGH	17.0000	9.20598			
		TOTAL	14.6000	6.07198			
	Total	LOW	14.1935	4.43035			
		HIGH	17.4483	7.65593			
		TOTAL	15.7667	6.36294			
FOOT ANGLE BETWEEN 1 AND 2 FOOT	Transmen	LOW	64.7000	13.70361	F=13.55 P=.001	F=1.171 P=.284	F=.334 P=.565
		HIGH	57.9500	14.51850			
		TOTAL	60.2000	14.38246			
	Transwomen	LOW	47.3810	14.31250			
		HIGH	45.3333	16.59066			
		TOTAL	46.7667	14.76875			
	Total	LOW	52.9677	16.14411			
		HIGH	54.0345	16.03007			
		TOTAL	53.4833	15.96128			
FOOT ANGLE BETWEEN 2 AND 3 FOOT	Transmen	LOW	47.5000	14.57738	F=2.855 P=.097	F=3.420 P=.070	F=.001 P=.976
		HIGH	54.7000	11.66236			
		TOTAL	52.3000	12.92191			
	Transwomen	LOW	41.1429	13.79596			
		HIGH	48.1111	17.12049			
		TOTAL	43.2333	14.92206			
	Total	LOW	43.1935	14.13369			
		HIGH	52.6552	13.62580			
		TOTAL	47.7667	14.57461			
FOOT ANGLE	Transmen	LOW	49.0000	15.47040			
		HIGH	51.90	11.7692			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
BETWEEN 3 AND 4 FOOT			00	7	F=1.497 P=.226	F=.139 P=.771	F=.052 P=.821
		TOTAL	50.9333	12.92134			
	Transwomen	LOW	44.1905	20.52467			
		HIGH	44.8889	21.55484			
		TOTAL	44.4000	20.46460			
	Total	LOW	45.7419	18.91731			
		HIGH	49.7241	15.41543			
		TOTAL	47.6667	17.28492			
FOOT ANGLE BETWEEN 4 AND 5 FOOT	Transmen	LOW	51.3000	28.13874	F=.023 P=.880	F=5.419 P=.024	F=.140 P=.710
		HIGH	65.5500	16.63375			
		TOTAL	60.8000	21.76425			
	Transwomen	LOW	52.4762	18.53273			
		HIGH	62.7778	10.75614			
		TOTAL	55.5667	17.08333			
	Total	LOW	52.0968	21.60610			
		HIGH	64.6897	14.91668			
		TOTAL	58.1833	19.57644			
LEFT STRIDE LENGTH	Transmen	LOW	85.9900	12.56401	F=.693 P=.409	F=1.835 P=.181	F=.792 P=.377
		HIGH	78.4400	12.08180			
		TOTAL	80.9567	12.55901			
	Transwomen	LOW	85.7952	12.08679			
		HIGH	84.2333	11.68054			
		TOTAL	85.3267	11.78640			
	Total	LOW	85.8581	12.03156			
		HIGH	80.2379	12.06120			
		TOTAL	83.1417	12.27457			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
RIGHT STRIDE LENGTH	Transmen	LOW	81.8200	20.22786	F=.321 P=.573	F=.016 P=.899	F=0.879 P=.769
		HIGH	80.1950	13.07052			
		TOTAL	80.7367	15.47638			
	Transwomen	LOW	82.8667	11.38189			
		HIGH	83.5111	12.49334			
		TOTAL	83.0600	11.51046			
	Total	LOW	82.5290	14.46935			
		HIGH	81.2241	12.76554			
		TOTAL	81.8983	13.57292			
LEFT STEP LENGTH	Transmen	LOW	46.5700	15.26747	F=.115 P=.736	F=1.281 P=.263	F=.574 P=.452
		HIGH	41.5850	7.00979			
		TOTAL	43.2467	10.49981			
	Transwomen	LOW	43.6762	8.04711			
		HIGH	42.6889	9.52437			
		TOTAL	43.3800	8.36035			
	Total	LOW	44.6097	10.72335			
		HIGH	41.9276	7.71566			
		TOTAL	43.3133	9.41003			
RIGHT STEP LENGTH	Transmen	LOW	43.6800	10.10091	F=.321 P=.573	F=1.882 P=.176	F=.277 P=.601
		HIGH	38.8000	10.00363			
		TOTAL	40.4267	10.13427			
	Transwomen	LOW	40.3857	8.65738			
		HIGH	38.2111	7.72552			
		TOTAL	39.7333	8.31755			
	Total	LOW	41.4484	9.11186			
		HIGH	38.61	9.22148			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
			72				
		TOTAL	40.0800	9.19826			
AVERAGE FOOT LENGTH	Transmen	LOW	24.2700	.84728	F=7.189 P=0.010	F=1.257 P=.267	F=.341 P=.562
		HIGH	23.6300	.83546			
		TOTAL	23.8433	.87992			
	Transwomen	LOW	25.0571	1.72614			
		HIGH	24.8556	1.69197			
		TOTAL	24.9967	1.68921			
	Total	LOW	24.8032	1.53025			
		HIGH	24.0103	1.27457			
		TOTAL	24.4200	1.45646			
2ND FOOT ANGLE	Transmen	LOW	15.5000	5.23344	F=2.597 P=.113	F=.133 P=.717	F=.046 P=.831
		HIGH	16.3000	5.40078			
		TOTAL	16.0333	5.26854			
	Transwomen	LOW	13.5714	3.98210			
		HIGH	13.7778	5.76146			
		TOTAL	13.6333	4.48356			
	Total	LOW	14.1935	4.43035			
		HIGH	15.5172	5.53960			
		TOTAL	14.8333	4.99887			
3RD FOOT ANGLE	Transmen	LOW	12.4000	4.81202	F=.190 P=.665	F=.176 P=.676	F=.317 P=.576
		HIGH	13.6000	2.98064			
		TOTAL	13.2000	3.65211			
	Transwomen	LOW	13.6190	5.19111			
		HIGH	13.4444	4.55826			
		TOTAL	13.5667	4.93183			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
	Total	LOW	13.2258	5.02467			
		HIGH	13.5517	3.45983			
		TOTAL	13.3833	4.30645			
4TH FOOT ANGLE	Transmen	LOW	11.0000	2.98142	F=.138 P=.711	F=1.996 P=.163	F=5.451 P=.023
		HIGH	15.0000	3.75570			
		TOTAL	13.6667	3.95957			
	Transwomen	LOW	13.0952	4.60331			
		HIGH	12.1111	2.61937			
		TOTAL	12.8000	4.08867			
	Total	LOW	12.4194	4.21722			
		HIGH	14.1034	3.65811			
		TOTAL	13.2333	4.01424			
5TH FOOT ANGLE	Transmen	LOW	13.2000	5.78888	F=.001 P=.979	F=.633 P=.430	F=.474 P=.494
		HIGH	15.8500	6.30184			
		TOTAL	14.9667	6.16712			
	Transwomen	LOW	14.4762	7.01868			
		HIGH	14.6667	5.83095			
		TOTAL	14.5333	6.58490			
	Total	LOW	14.0645	6.57741			
		HIGH	15.4828	6.08054			
		TOTAL	14.7500	6.32891			
PRINCIPAL ANGLE BETWEEN 2ND AND 3RD FOOT	Transmen	LOW	36.0000	8.85689	F=16.198 P=.000	F=3.478 P=.067	F=.104 P=.749
		HIGH	40.5000	6.95474			
		TOTAL	39.0000	7.79036			
	Transwomen	LOW	28.3810	7.23517			
		HIGH	31.55	7.07303			

VARIABLES	GENDER	EXTRAVERSION	MEAN	Std. Deviation	F and p	F and P (P)	INTERACTION G/P
			56				
		TOTAL	29.3333	7.21748			
	Total	LOW	30.8387	8.45812			
		HIGH	37.7241	8.05293			
		TOTAL	34.1667	8.89899			

Overall, no significant mean differences existed for transgender people for low and high extraversion for the majority of gait parameters, however, for the fourth- and fifth-foot angles, high extraversion was associated with a greater foot angles. There was a significant gender difference in foot angle between the first and second feet, average foot length, and mean angle between the second and third feet, with trans men having a higher angular values and trans women having higher average foot length. The only significant gender-extraversion interaction was for the fourth foot angle.

Table 6 Two–Way Annova Analysis of Gait Variables W.R.T Gender, Openness to Experience Personality Trait and Interaction between Gender and Openness to Experience.

VARIABLES	GENDER	OP TO EXP	MEAN	Std. Deviation	F and p for gender	F and P (P) for OP	Interaction of G/P
SECOND FOOT ANGLE	Transmen	LOW	15.2308	4.60351	F=.939 P=.337	F=1.242 P=.270	F=.257 P=.614
		HIGH	18.2353	7.57074			
		TOTAL	16.9333	6.53338			
	Transwomen	LOW	14.3750	6.19125			
		HIGH	15.5000	6.02495			
		TOTAL	14.6000	6.07198			
	Total	LOW	14.6757	5.63252			
		HIGH	17.5217	7.17236			
		TOTAL	15.7667	6.36294			
FOOT ANGLE BETWEEN 1 AND 2	Transmen	LOW	64.8462	15.27441	F=8.089 P=.006	F=.038 P=.845	F=3.042 P=.087
		HIGH	56.6471	12.99972			
		TOTAL	60.2000	14.38246			
	Transwomen	LOW	45.4583	15.02166			
		HIGH	52.0000	13.63818			
		TOTAL	46.7667	14.76875			
	Total	LOW	52.2703	17.60626			
		HIGH	55.4348	13.02035			
		TOTAL	53.4833	15.96128			
	Transmen	LOW	47.0000	12.01388			

VARIABLES	GENDER	OP TO EXP	MEAN	Std. Deviation	F and p for gender	F and P (P) for OP	Interaction of G/P
FOOT ANGLE BETWEEN 2 AND 3		HIGH	56.3529	12.41441	F=2.898 P=.094	F=3.337 P=.073	F=.250 P=.619
		TOTAL	52.3000	12.92191			
	Transwomen	LOW	42.1667	14.48738			
		HIGH	47.5000	17.28294			
		TOTAL	43.2333	14.92206			
	Total	LOW	43.8649	13.69948			
		HIGH	54.0435	13.99181			
		TOTAL	47.7667	14.57461			
FOOT ANGLE BETWEEN 3 AND 4	Transmen	LOW	48.2308	14.06624	F=1.249 P=.269	F=.417 P=.521	F=.086 P=.771
		HIGH	53.0000	11.98958			
		TOTAL	50.9333	12.92134			
	Transwomen	LOW	44.0417	19.50135			
		HIGH	45.8333	26.01090			
		TOTAL	44.4000	20.46460			
	Total	LOW	45.5135	17.69278			
		HIGH	51.1304	16.39097			
		TOTAL	47.6667	17.28492			
FOOT ANGLE BETWEEN 4 AND 5	Transmen	LOW	57.0769	27.40578	F=.130 P=.720	F=1.856 P=.179	F=.048 P=.828
		HIGH	63.6471	16.59421			
		TOTAL	60.8000	21.76425			
	Transwomen	LOW	53.7500	17.51087			
		HIGH	62.8333	14.24664			
		TOTAL	55.5667	17.08333			
	Total	LOW	54.9189	21.18618			
		HIGH	63.4348	15.70126			
		TOTAL	58.1833	19.57644			
LEFT STRIDE LENGTH	Transmen	LOW	87.2538	10.33220	F=2.183 P=.145	F=.878 P=.353	F=5.376 P=.024
		HIGH	76.1412	12.20492			
		TOTAL	80.9567	12.55901			
	Transwomen	LOW	84.3833	11.52206			
		HIGH	89.1000	13.17907			
		TOTAL	85.3267	11.78640			
	Total	LOW	85.3919	11.06040			
		HIGH	79.5217	13.47816			
		TOTAL	83.1417	12.27457			
RIGHT STRIDE LENGTH	Transmen	LOW	81.6385	17.41860	F=.295 P=.590	F=.040 P=.842	F=.037 P=.849
		HIGH	80.0471	14.33196			
		TOTAL	80.7367	15.47638			
	Transwomen	LOW	83.0667	12.38631			
		HIGH	83.0333	7.91901			
		TOTAL	83.0600	11.51046			
	Total	LOW	82.5649	14.12913			
		HIGH	80.8261	12.86218			
		TOTAL	81.8983	13.57292			
	Transmen	LOW	46.3769	13.27750	F=.483	F=.079	F=5.401
		HIGH	40.8529	7.31797			

VARIABLES	GENDER	OP TO EXP	MEAN	Std. Deviation	F and p for gender	F and P (P) for OP	Interaction of G/P
LEFT STEP LENGTH		TOTAL	43.2467	10.49981	P=.490	P=.779	P=.024
	Transwomen	LOW	41.9708	8.28038			
		HIGH	49.0167	6.50674			
		TOTAL	43.3800	8.36035			
	Total	LOW	43.5189	10.34971			
		HIGH	42.9826	7.87428			
		TOTAL	43.3133	9.41003			
RIGHT STEP LENGTH	Transmen	LOW	42.6462	9.22105	F=1.036 P=.313	F=3.361 P=.072	F=.141 P=.708
		HIGH	38.7294	10.73853			
		TOTAL	40.4267	10.13427			
	Transwomen	LOW	40.9208	8.20975			
		HIGH	34.9833	7.57428			
		TOTAL	39.7333	8.31755			
	Total	LOW	41.5270	8.49123			
		HIGH	37.7522	9.98667			
		TOTAL	40.0800	9.19826			
AVERAGE FOOT LENGTH	Transmen	LOW	24.2462	.77526	F=8.134 P=.006	F=.666 P=.418	F=.970 P=.329
		HIGH	23.5353	.84848			
		TOTAL	23.8433	.87992			
	Transwomen	LOW	24.9833	1.70107			
		HIGH	25.0500	1.79861			
		TOTAL	24.9967	1.68921			
	Total	LOW	24.7243	1.47524			
		HIGH	23.9304	1.31198			
		TOTAL	24.4200	1.45646			
2^{ND} FOOT ANGLE	Transmen	LOW	15.2308	4.60351	F=1.246 P=.269	F=1.699 P=.198	F=.102 P=.751
		HIGH	16.6471	5.78728			
		TOTAL	16.0333	5.26854			
	Transwomen	LOW	13.1667	4.03966			
		HIGH	15.5000	6.02495			
		TOTAL	13.6333	4.48356			
	Total	LOW	13.8919	4.29977			
		HIGH	16.3478	5.73354			
		TOTAL	14.8333	4.99887			
3^{RD} FOOT ANGLE	Transmen	LOW	11.3846	3.57161	F=.197 P=.659	F=1.559 P=.217	F=1.730 P=.194
		HIGH	14.5882	3.14362			
		TOTAL	13.2000	3.65211			
	Transwomen	LOW	13.5833	5.24128			
		HIGH	13.5000	3.83406			
		TOTAL	13.5667	4.93183			
	Total	LOW	12.8108	4.78910			
		HIGH	14.3043	3.28128			
		TOTAL	13.3833	4.30645			
	Transmen	LOW	12.0769	3.40249			

VARIABLES	GENDER	OP TO EXP	MEAN	Std. Deviation	F and p for gender	F and P (P) for OP	Interaction of G/P
4TH FOOT ANGLE		HIGH	14.8824	4.01376	F=.911 P=.344	F=.360 P=.551	F=3.328 P=.073
		TOTAL	13.6667	3.95957			
	Transwomen	LOW	13.0833	4.26224			
		HIGH	11.6667	3.38625			
		TOTAL	12.8000	4.08867			
	Total	LOW	12.7297	3.96266			
		HIGH	14.0435	4.05057			
		TOTAL	13.2333	4.01424			
5TH FOOT ANGLE	Transmen	LOW	12.6154	4.44482	F=.000 P=.992	F=1.633 P=.207	F=.927 P=.340
		HIGH	16.7647	6.79641			
		TOTAL	14.9667	6.16712			
	Transwomen	LOW	14.4167	6.03552			
		HIGH	15.0000	9.14330			
		TOTAL	14.5333	6.58490			
	Total	LOW	13.7838	5.53341			
		HIGH	16.3043	7.29530			
		TOTAL	14.7500	6.32891			
PRINCIPAL ANGLE BETWEEN 2ND AND 3RD FOOT	Transmen	LOW	35.5385	7.28715	F=16.53 P=.000	F=3.482 P=.067	F=.979 P=.327
		HIGH	41.6471	7.27960			
		TOTAL	39.0000	7.79036			
	Transwomen	LOW	28.9583	7.29192			
		HIGH	30.8333	7.35980			
		TOTAL	29.3333	7.21748			
	Total	LOW	31.2703	7.86218			
		HIGH	38.8261	8.62687			
		TOTAL	34.1667	8.89899			

The average foot lengths, left and right stride lengths, left and right step lengths, and the foot angles between the first and second feet, second and third feet, and third and fourth feet, as well as the second- and third-foot angles, did not reveal a significant mean difference between transgender individuals with low and high openness to experience. Given that the majority of gait measurements showed a non-significant interaction affect with gender, openness to experience had a comparable impact on these indicators for trans women and trans males.

However, those who were more open to experience revealed significantly greater foot angles between the fourth and fifth feet as compared to those who were less open to experience. The second foot angle, third foot angle, and the foot angles between the first and second feet all had significant gender effects; trans men typically had more angular values. However, trans women's average foot lengths were longer. The angle shown between the fourth foot also had a significant gender-openness interaction effect, suggesting there are gender differences in openness to experience and this gait trait.

DISCUSSION

Major Findings

- With respect to demographic variables, there were no statistically significant differences between trans men and trans women for height, weight or age (all $p > .05$).
- Few gait parameters showed significant differences for the foot angle (between the 1st–2nd and 2nd-3rd feet), the principal angle (between the 2nd–3rd feet), and average foot length (all $p < .05$).
- Other gait parameters like stride length and step length (including other angles) did not show statistically significant difference between groups.
- Regarding personality traits, chi-square tests showed that trans men scored significantly higher than trans women in extraversion ($p = .004$) and openness to experience ($p = .003$).
- Gait-personality relationship showed that trans men had significantly greater extraversion and openness to experience were associated with greater 4th–5th foot angles and longer stride/step lengths.
- Overall, the combination of gait parameters and personality traits provided better indices for gender identification than either gait parameter or personality trait alone and both variables may have potential forensic applied value for future researchers to explore.

This study highlighted gait characteristics of transgender individuals in relation to personality traits and their possible forensic relevance. There were no meaningful differences in most of the gait parameters across groups. However, there were significant differences in foot angle between the first and second feet, the principal angle between the second and third feet, and average foot size. Trans men had larger angular values compared to trans women, and trans women had longer average foot size, showing that gait can represent quantifiable differences between gender identities. (Krishan, Kanchan, & DiMaggio, 2015) (Nagare, Naik, & Khopkar, 2018)

Personality traits provided another layer of nuance. Extraversion and openness to experience was higher in transmen, and gait characteristics (e.g. fourth foot angle, stride length, step length) exhibited interaction effects with personality. The results suggest that while psychological characteristics may influence movement in a subtle way, they are not sufficient to be considered a forensic marker on their own. (Costa&McCrae,1992) (Goldberg,1993).

From a practical perspective, gait and personality profiling together are promising as an additional resource for cases where biological evidence is limited or absent. Many gait features were unreliable for male or female classification, and considerations for biological

variation due to hormonal treatments, surgical reconstruction, dress, and musculoskeletal variation should be given full consideration. (Wierckx et al., 2014) (Wiik et al., 2019).

In summary gait analysis and personality trait should be thought as complementary aspects of a multi-factorial forensic context that necessitates standardization, ethical consideration and interdisciplinary cooperation for valid use in the court.

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Conflict of Interest

The author(s) declared no conflict of interest.

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