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CONSTRUCTION AND VALIDATION OF INDIGENOUS PSYCHO-NEUROLOGICAL MANUAL DEXTERITY TEST: ABANINIK PSYCHO-NEUROLOGICAL MANUAL DEXTERITY TEST

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ABSTRACT

The project is designed for the construction and validation of an indigenous psycho-neurological manual dexterity test that is known as (ABANINIK PSYCHO-NEUROLOGICAL MANUAL DEXTERITY TEST). The manual dexterity test can used in the selection and placement of workers in the factories and companies. It can be used to select workers who work basically with their hands in Factories such as Bottling Companies, Pharmaceutical Companies, Confectionary Companies, and Textile Companies. This manual dexterity test can also detect the early signs of neurological breakdown (Parkinsonism). One-way Analysis of Variance and the T-test of independent measures was employed to manage the data of this research project. The findings show that there is no significant gender difference on participant performance on Abaninik psycho-neurological manual dexterity test (APMDT) The result also shows that there is significant difference on the performance of the participants in the five compartments of excellent performance, above average performance, average performance, below average performance, and very performance in Abaninik Psycho-Neurological manual dexterity test. The result also shows independent number and means of gender in the above five compartments of the new manual dexterity test. The standing of these five compartments was shown in graphical layout below. Recommendations were made among others that Future studies should examine inter-rater reliability, and other appropriate reliability indices. Evidence of content, construct, criterion-related, and predictive validity should also be established to determine the extent to which the test accurately measures manual dexterity and associated psycho-neurological functioning.

Keywords: *Construction, Validation, Psycho-Neurological, Manual Dexterity Test, Abaninik Psycho-Neurological Manual Dexterity Test.*

INTRODUCTION

Dexterity is the capacity to coordinate hand and finger movements precisely to grasp, manipulate, and control objects effectively. It represents an intricate motor function governed by various interrelated physiological factors, including structural hand development, muscular strength, joint range of motion, muscle tone, sensory processing, and neuromuscular control. Because an impairment in any of these individual components can compromise overall manual function, a thorough assessment of dexterity must account for each contributing factor. Evaluating manual dexterity in infants and young children under three years old presents unique clinical challenges due to the rapid pace of early neurodevelopment and motor skill acquisition. To account for this dynamic growth, standardized developmental tools—such as fine-motor subscales like the Peabody Developmental Motor Scales, Second Edition (PDMS-2)—are commonly employed to screen for and diagnose early motor delays (Ashworth, 2024).

When detailed insights into hand function and fine manipulation are required, broader developmental screenings often prove insufficient, necessitating more targeted evaluations. A practical clinical strategy involves structured observational assessment as children engage with standardized arrays of objects varying in geometry, dimensions, and tactile surface characteristics. This setup allows evaluators to systematically analyze a wide range of grasp

topologies and in-hand manipulation behaviors. Furthermore, bilateral comparisons between limbs can highlight functional asymmetries, while longitudinal re-testing using matched tasks helps track motor trajectories and therapeutic progress over time. Given the inclusion of small test items, strict adherence to safety protocols—including the use of non-toxic, age-appropriate materials to mitigate choking hazards—remains essential during early childhood testing (Ashworth, 2024).

Several standardized instruments are available for the objective assessment of manual dexterity in children and other populations. These include the Functional Dexterity Test (FDT), the Box and Block Test, and the Nine-Hole Peg Test. The Functional Dexterity Test primarily assesses in-hand manipulation by requiring an individual to pick up, rotate, and place pegs into designated positions. Performance is typically evaluated according to the time taken to complete the task and errors or difficulties observed during administration. The Box and Block Test assesses gross manual dexterity by requiring an individual to transfer blocks from one compartment to another within a specified period. It can provide useful information about upper-limb motor performance, although adequate proximal control and the ability to grasp and release objects are necessary for successful completion of the task. Similarly, the Nine-Hole Peg Test is commonly used to assess fine manual dexterity and finger coordination. Beyond providing quantitative measures of performance, these standardized assessments allow clinicians and researchers to observe compensatory movements, coordination difficulties, and other functional limitations that may not be fully reflected in test scores alone (Ashworth, 2024).

In clinical and therapeutic research, blinding is an important methodological strategy for reducing bias and improving the validity of conclusions regarding the safety and effectiveness of an intervention. In a single-blind design, participants are unaware of the treatment or group to which they have been assigned, thereby helping to reduce expectancy and placebo-related effects. In a double-blind design, both participants and relevant investigators or assessors are unaware of treatment allocation, which can further reduce the influence of observer expectations and measurement bias.

In clinical trials—particularly those focused on neurological disorders—blinding serves as a critical methodological control when outcome measures rely on clinician observation or patient self-report. Shielding participants and evaluators from group assignments minimizes expectation bias, thereby reinforcing the internal validity and overall trustworthiness of experimental results. While blinding is now a standard pillar of rigorous research design, tracing its historical emergence within neurology highlights how scientific methodologies have continually evolved to enhance data precision and reproducibility.

Fundamentally, everyday independence depends on key cognitive domains, including sustained attention, memory encoding, orientation, executive control, and sound decision-making (Lindberg et al., 2024). However, a cerebrovascular accident (stroke) frequently disrupts these complex networks, precipitating a triad of cognitive, sensory, and motor deficits that severely diminish functional autonomy and personal well-being. Upper-extremity dysfunction represents one of the most prevalent post-stroke complications, typically manifesting as hemiparesis, compromised motor control, spasticity, muscular weakness, or somatosensory deficits. Collectively, these impairments severely restrict manual dexterity, making it difficult for survivors to grasp, manipulate, or control everyday objects (Kwakkel et al., 2023; Langhorne et al., 2011; Pennati et al., 2020; Santisteban et al., 2016).

Manual dexterity is the capacity to execute precise, coordinated, and goal-directed movements using the hands and fingers. As a crucial element of upper-extremity function, it supports essential daily activities such as gripping objects, handwriting, dressing, self-feeding, and executing work-related tasks. In contrast, upper-limb motor function encompasses a broader physiological spectrum, integrating motor control, muscular force, joint coordination, and movement across the entire upper-body chain—including the shoulder, arm, wrist, and hand. Within this framework, fine motor skills represent a distinct subset of upper-limb abilities centered specifically on subtle, high-precision digit manipulation.

Because post-stroke brain lesions differ in location and severity, neurological injury yields highly variable combinations of physical, cognitive, sensory, and affective impairments across individuals. Consequently, functional trajectories range from significant motor recovery and personal autonomy to severe, long-term disability requiring lifelong care (Perez-Cruzado et al., 2017).

Occupational therapy serves as a cornerstone in post-stroke and acquired brain injury rehabilitation. The overarching goal of occupational therapy is to restore functional independence, foster active engagement in daily roles, and maximize personal autonomy. To optimize hand function and dexterity, therapists utilize personalized, evidence-based modalities, including task-oriented training, isolated fine-motor exercises, bilateral limb integration, sensory re-education, assistive devices, and virtual reality-based therapy. These strategies are customized according to each patient's functional baseline, clinical presentation, and personal goals (Constantinovici et al., 2025).

From a neuroscientific perspective, the interplay between manual dexterity and cognitive processing is grounded in brain connectivity and neuroplasticity. Brain connectivity denotes the structural pathways and functional cross-talk across distinct neural regions, whereas neuroplasticity describes the central nervous system's capacity to reorganize its architecture and operational pathways in response to novel experiences, practice, and therapeutic input. Engaging in targeted, repetitive, and task-oriented motor practice can stimulate adaptive neural remodeling across networks governing motor control, sensory feedback, and cognitive function.

The dynamic interplay between cognitive and motor domains plays a central role in neurorehabilitation following a stroke. Successful motor skill re-acquisition relies heavily on cognitive capacities, including focused attention, working memory, procedural planning, performance monitoring, and executive control. Deficits in any of these cognitive operations can hamper a patient's ability to acquire, retain, and generalize motor skills to real-world tasks. Consequently, functional motor recovery cannot be treated as a purely physical process; rather, it is an integrative outcome shaped by neurological, cognitive, sensory, and environmental interactions.

Several conceptual frameworks illuminate this cognitive-motor synthesis:

- **Embodied Cognition:** Asserts that cognitive processing is deeply rooted in physical, sensory, and bodily interactions with the surrounding environment.
- **Cognitive-Motor Interference Theory:** Posits that simultaneous motor and cognitive tasks draw from a shared, finite pool of attentional resources, often resulting in performance trade-offs when demands exceed capacity.

- **Task-Oriented Motor Learning:** Stresses that functional recovery and neural adaptation are best driven by repetitive, goal-directed, and contextually meaningful practice (Plummer et al., 2013; Shapiro & Spaulding, 2025; Mou & Jiang, 2025).

Beyond neurological recovery, manual dexterity serves as a prerequisite in professional fields that demand high-precision physical performance. It relies on the seamless integration of visuospatial processing, fine digit control, tactile feedback, and hand–eye coordination. This fine motor proficiency is essential in technical professions like dentistry, where clinical competence hinges on manipulating delicate instruments and materials with speed, stability, and millimeter-level accuracy. As a result, manual dexterity is recognized as a foundational skill for dental trainees and clinicians, particularly during early preclinical simulation and complex restorative procedures (Lundergan et al., 2007; Dimitrijevic et al., 2011; Koo et al., 2025).

A variety of traditional evaluation tools—including the Purdue Pegboard Test, the O'Connor Finger Dexterity Test, and the Minnesota Rate of Manipulation Test—are widely used to measure manual dexterity. Although these tests yield standardized metrics for general hand and digit coordination, they fail to capture the specific fine-motor and spatial demands inherent to dental procedures (Berger et al., 2009; Andersen et al., 2009; Yancosek & Howell, 2009). Addressing this gap, Neves et al. (2020) introduced the Dental Manual Dexterity Assessment, a straightforward, reproducible tool specifically engineered to measure manual skills within a restorative dentistry context. Tailoring assessments to a specific discipline offers clearer, more direct insight into how a student's baseline motor competence translates to preclinical clinical performance.

Domain-specific motor evaluations play an important role in dental education by bridging the gap between physical aptitude and technical skill acquisition. These instruments help educators screen for students who may benefit from early remediation while tracking motor skill development throughout clinical training. However, the existing literature remains constrained by a paucity of studies utilizing dentistry-specific testing tools, making it difficult to establish which metrics best predict preclinical success (Lugassy et al., 2018; Urbankova & Engebretson, 2011). At the onset of preclinical coursework, novice trainees frequently struggle with procedures requiring fine coordination and micro-movements. In restorative dentistry, this initial lack of manual dexterity often coincides with low task self-efficacy, potentially slowing a student's adaptation to hands-on clinical environments (Gonzalez et al., 2015; Tuncer et al., 2015).

Developing manual dexterity is essential across all technical disciplines that rely on precise, repeatable, and coordinated hand control. Unaddressed motor deficits and inadequate skill tracking can undermine student confidence and impede the mastery of practical competencies. Structured practice, expert supervision, targeted feedback, and progressive training remain vital for fostering high-level manual control (Al Saud et al., 2017; Gonzalez et al., 2015; Neves et al., 2023). Because hand function directly impacts execution speed, work quality, and safety in precision-driven fields, early screening provides significant utility. Educational Contexts, enables faculty to implement timely, targeted motor interventions for students demonstrating lower baseline dexterity. Occupational & Industrial Contexts, Informs task placement and training needs by quantifying a worker's capacity for rapid, high-precision manual control (Urbankova & Engebretson, 2011; Neves & Garcia, 2018).

Against this background, the present study seeks to examine the effectiveness of the Abaninik Psycho-Neurological Manual Dexterity Test, an indigenous instrument developed to assess manual dexterity, in evaluating workers whose occupations require efficient and coordinated use of the hands. The study is particularly relevant to employees in pharmaceutical and bottling companies, manufacturing industries, confectionery and textile industries, and other factory settings where workers perform tasks involving repetitive and precise hand movements. Such occupations may include activities such as sorting, assembling, packaging, sealing, corking, handling materials, and operating or manipulating work-related equipment. The Abaninik Psycho-Neurological Manual Dexterity Test may therefore provide a useful means of assessing workers' capacity for coordinated and effective hand movements that are relevant to their occupational responsibilities.

The findings of the study may contribute to the development of appropriate methods for assessing manual dexterity in occupational settings. In particular, the instrument may assist employers, researchers, occupational psychologists, and other relevant professionals in identifying variations in workers' manual performance and determining areas in which additional training or intervention may be beneficial to the organizational workforce.

Concept of Manual Dexterity

Manual dexterity represents the capacity to execute precise, fluent, coordinated, and goal-directed movements using the hands and digits. It relies on the complex interplay of visual perception, hand–eye synchronization, somatosensory feedback, central motor planning, and fine muscle control. This refined motor capacity is essential for tasks demanding delicate tool manipulation, small-object handling, and high-frequency, repeatable micro-movements.

While extensively studied within dental pedagogy, manual dexterity plays an equally vital role across diverse occupational and manufacturing environments. Technical operators in pharmaceutical manufacturing, assembly, bottling, automated packaging, textile fabrication, and related industrial sectors routinely execute workflows requiring rapid, highly coordinated, and sustained hand-arm control. In these precision-dependent sectors, baseline motor deficits can significantly compromise operational throughput, product quality, error rates, and overall task accuracy (Saeed et al., 2022).

Assessment of Manual Dexterity

A range of validated assessment tools exists to evaluate manual dexterity, with widely recognized instruments including the Purdue Pegboard Test, the O'Connor Finger Dexterity Test, and the Minnesota Rate of Manipulation Test. Across clinical, educational, and industrial settings, these standardized metrics measure various dimensions of digit coordination, movement velocity, and object manipulation. However, selecting an appropriate evaluation tool depends heavily on the target population and the unique motor demands of a given setting. While traditional instruments offer broad benchmarks for general manual performance, they often fail to capture the specialized micro-movements and spatial control required in technical professions. To address this gap within dental education, researchers developed discipline-specific alternatives, such as the Dental Manual Dexterity Assessment introduced by Neves et al. (2020), which specifically evaluates motor skills essential for restorative dentistry. The emergence of such tailored instruments highlights the necessity of aligning assessment

protocols with the precise functional requirements of the field under study (Aaron & James, 2003; Neves et al., 2020).

Manual Dexterity and Practical Performance

Manual dexterity is intrinsically linked to technical skill acquisition and practical performance. Individuals possessing well-developed visual-motor integration and refined fine motor control generally adapt more readily to tasks that demand physical precision and delicate object manipulation. However, manual dexterity operates as just one element within a broader matrix of factors governing professional and occupational competence. Other critical variables—such as clinical experience, structured training, task familiarity, intrinsic motivation, attentional focus, visual acuity, and effective instructional guidance—also exert a substantial influence on performance success. In academic environments, early evaluation of manual skills enables educators to identify students who may require targeted practice or tailored remedial support. Likewise, within industrial and occupational contexts, evaluating manual dexterity yields valuable data that can inform employee training programs, skill-building strategies, job placement decisions, and ongoing assessments of workplace motor efficiency (Corti et al., 2017).

Manual Dexterity in Occupational and Industrial Settings

Numerous industrial workflows depend on employees executing hand movements with high efficiency, consistency, and endurance. On a daily basis, personnel are regularly tasked with gripping, sorting, assembling, packaging, sealing, labeling, capping, and handling diverse equipment or materials. Optimal execution of these operational duties requires the seamless integration of fine motor precision, visual-spatial guidance, physical speed, movement accuracy, and sustained cognitive focus.

Despite the critical role manual proficiency plays in industrial performance, measuring these competencies requires assessment tools that reflect the specific cultural context and operational realities of the target workforce. Developing and validating indigenous evaluation instruments offers distinct advantages, ensuring that testing protocols closely align with the unique functional demands, baseline characteristics, and workplace environments of the local population (Abamara, 2025).

Relevance of the Abaninik Psycho-Neurological Manual Dexterity Test

The Abaninik Psycho-Neurological Manual Dexterity Test (APDMT) is an indigenous assessment tool designed to evaluate manual dexterity. It is particularly applicable in occupational environments where fine hand coordination, object manipulation, and precise, repetitive motor skills directly impact job performance. This study examines the practical utility and effectiveness of the APDMT in measuring employees' capacity for coordinated, goal-directed hand movements. The evaluation focuses on industrial and factory settings—such as pharmaceutical, bottling, confectionery, and textile manufacturing—where manual precision is essential. Assessing the APDMT within these specific operational environments contributes to the development of culturally and contextually adapted testing protocols. Furthermore, it offers valuable baseline insights into the instrument’s broader application for occupational assessment, skill evaluation, workforce training, and future research (Genaro et al., 2024).

While conventional dexterity tests have established a strong foundation for measuring fine motor control, there remains a distinct need for instruments tailored to specific populations and operational contexts. The APDMT addresses this gap by offering a localized framework for evaluating hand-eye coordination. Investigating its performance among factory workers provides critical evidence of its real-world applicability as an occupational assessment tool. To fully establish its utility, subsequent research must determine its psychometric rigor—specifically its reliability, construct validity, normative benchmarks, and direct correlation with key performance metrics (Favilla et al., 2026).

Empirically, Investigating the quality of human movement is inherently complex, as motor performance is shaped by an intricate interplay of physiological, cognitive, biomechanical, and environmental factors. Achieving a comprehensive understanding of motor control requires systematic data gathering across multiple domains alongside robust analytical frameworks. Within this broader scope, manual dexterity refers to the capacity to execute coordinated, goal-directed movements of the hands and fingers when manipulating objects. Early conceptualizations viewed dexterity somewhat narrowly as mere physical speed and efficiency during object manipulation (Aaron & Jansen, 1992).

Modern research, however, recognizes manual dexterity as a multidimensional construct that cannot be captured by a single metric. Functional studies increasingly focus on the specific mechanics of grasping, manipulating, and releasing items. Because these actions are central to daily functioning, contemporary assessments prioritize tasks that mirror activities of daily living (ADLs), offering a more authentic reflection of real-world hand function. To evaluate these movements objectively, researchers frequently employ kinematic analysis. By tracking metrics such as movement duration, velocity, spatial trajectories, inter-limb coordination, and motor variability, kinematic methods reveal subtle nuances in movement quality and efficiency. These objective measures allow researchers to pinpoint the precise movement profiles that underpin successful task execution.

Choosing the right diagnostic tool is critical, as different instruments target distinct components of motor control. When selecting an evaluation method, researchers must carefully weigh factors such as the specific purpose of the assessment, target population characteristics, functional task relevance, and the availability of standardized normative data.

Factor-analytic research demonstrates that manual dexterity is a multifaceted capacity rather than a single, isolated trait. Foundational psychometric studies indicate that dexterity comprises multiple distinct yet interrelated sub-abilities, with performance fluctuating based on specific task demands (Buxton, 1938; Wittenborn, 1945; Fleishman & Hempel, 1954). Consequently, a person's score on a single manual test rarely reflects their global manual capacity. Capturing an accurate profile of hand function requires multi-dimensional evaluation protocols, as manual performance relies on the ongoing interplay of cognitive processes, muscular strength, and motor control during goal-directed tasks (Yoxall et al., 2007; Lee & Newell, 2012). Cognitive processing is integral to motor execution. Encompassing functions such as executive control, spatial attention, and working memory (Sternberg & Sternberg, 2012), cognition enables the brain to plan, initiate, monitor, and adjust hand movements in real time (Blomberg, 2011). Efficient object manipulation requires more than neuromuscular strength; it demands perceiving environmental feedback, selecting motor strategies, and dynamically revising movements.

Cognitive constraints can directly impair motor performance—particularly when tasks are novel, structurally complex, or time-sensitive.

Furthermore, motor execution is strongly mediated by experience and practice. Through repetition, individuals refine motor programs to perform movements with higher speed, efficiency, and adaptability. Experience enhances a person's ability to navigate unexpected perturbations during manual tasks (Latash & Turvey, 1996). When assessing manual dexterity, researchers must account for these learning effects. Familiarity with a specific test protocol can lead to performance gains driven by task familiarity and strategic adaptation rather than an increase in baseline motor capacity. Accounting for practice effects is therefore critical when designing dexterity trials and interpreting longitudinal assessment data.

Muscular strength serves as a foundational element of upper-limb mechanics, enabling individuals to grasp, hold, and manipulate objects against resistance or under sustained load. However, force production alone does not guarantee successful object manipulation. An individual can exhibit normal muscular strength yet encounter significant challenges when performing tasks that demand fine temporal precision, spatial accuracy, or rapid motor corrections. This divergence underscores a crucial distinction in hand evaluation: strength measures maximum force capability, whereas dexterity reflects the controlled, goal-directed coordination of movement. A robust assessment protocol must therefore evaluate both force generation and motor control as independent variables. While research has extensively covered muscle strength, cognitive processing, and learning dynamics in hand-object interactions, the subtle nuances and boundary conditions of manual dexterity require further empirical clarification. Advancing our understanding of these motor mechanisms is essential for designing sensitive diagnostic tools, targeted clinical protocols, and effective rehabilitation regimens for individuals with functional hand impairments (Vanbellingen, 2011; von Hofsten, 1991).

The practical value of mapping manual dexterity extends beyond clinical evaluation into rehabilitation tracking and industrial design. Within clinical settings, granular profiling of hand function enables clinicians to pinpoint specific motor deficits, tailor individual interventions, and track therapeutic outcomes over time. Outside the clinic, understanding manual dexterity is critical for product development and ergonomics. When product engineering fails to account for real-world variations in hand function and pinch mechanics, everyday devices and work equipment create functional barriers to user independence. Implementing human-centered and inclusive design frameworks requires a thorough accounting of the broad diversity in human manipulative capability (Pennathur et al., 2003; Yoxall et al., 2007; Yoxall et al., 2013; Keates et al., 2000).

In summary, current literature establishes manual dexterity as a complex, multidimensional domain of human motor performance. It relies on the dynamic interaction of several core components, including neuromuscular control, force production, cognitive processing, prior experience, and specific task constraints. Because manual performance is inherently context-dependent, no single metric or isolated test can fully capture the full spectrum of hand function.

While objective methodologies—such as kinematic tracking and standardized battery testing—yield valuable data on movement efficiency, spatial trajectory, and motor coordination, broader gaps remain. Further empirical research is required to refine evaluation tools so they

accurately reflect functional hand use across diverse clinical, industrial, and cultural environments. Addressing these contextual nuances is especially vital for validating and advancing localized assessment tools, such as the Abaninik Psycho-Neurological Manual Dexterity Test (APDMT), ensuring they offer culturally grounded and operationally meaningful measures of hand performance.

Statement of the Problem

Most of the time, people take for granted the trembling nature of their hands. The trembling hands or limbs may be as a result of excessive intake of alcohol beverages. Excessive intake of alcohol beverages may affect the human nerve and lead to its break down. Apart from neurological diagnosis by medical experts (Neurologists), there are no known standardized psychological instruments that can be employed to assess and discriminate against individuals who manifest early signs of trembling or shaky hands.

Secondly, there are also no known standardized instruments for the selection and placement of workers in the factories and companies, more especially the workers who work with their hands. For instance, workers who are selected and placed to work in pharmaceutical companies, bottling companies and textile factories. The study (manual dexterity project) will be designed and fabricated to assess and discriminate against patients and participants who may manifest early sign of neural breakdowm (parkinsonism). The Study (manual dexterity project) will also be designed and fabricated to be used in selection and placement in factories and companies. The manual dexterity device will be basically used to employ workers that work exclusively with their hands. For instance, workers that will be selected and placed to work in the pharmaceutical companies, bottling companies, and textile companies (Abamara, 2025).

Against this backdrop, two hypotheses were postulated to guide this study/project, and they are as follows:

1. Male participant will perform better in the Abaninik psycho-neurological manual dexterity test than the female participants.
2. Participants will significantly perform differently across five compartments of Abaninik psycho-neurological manual dexterity test.

METHODS

Participants:

A total of four hundred (400) participants were selected for the construction of the Abaninik Psycho-Neurological manual dexterity test. The participants were selected from five Organisations in the capital city of three states in the Southeast geopolitical zone, namely Awka, Owerri, and Enugu. In Awka Millenium and Juhel Pharmaceutical industries was selected as a research setting, In Owerri, Rokana Industries Plc and Mangero water factory was selected as research setting. In Enugu, Nigerian Bottling Company (Coca-Cola) was selected as the research setting. In the sampled population of 400 participants, 250 were males which is (62.5%) of the sampled population, 150 were females which is (37.5%) of the sampled population. By religious affiliations, 350, (87.5%) were Christians, 30 (7.5%) were Muslims, 10 (2.5%) were of Jewish religion, and 10 (2.5%) had no specific religion. In their marital status, 160 (40%) of the sampled population were married, 229 (57.25%) were single, 12 (0.3%) were separated, while 8 (0.2%) were widow/widower. Their ages ranged from 20 to 60 years with a mean age of 40 and a standard deviation of 28.2.

Ethical Consideration

The research adhered strictly to ethical standards, participation in this study was voluntary, and informed consent was obtained from all the partcipants prior to the administration of Abaninik

Psycho-neurological Manual Dexterity Test. Confidentiality and anonymity were ensured, and participants were informed of their right to withdraw from this research exercise at any point without negative consequences arising from their withdrawal. All participants were fairly treated without bias. The administration of the new manual dexterity test was administered in a calm and supportive environment, and all the participants were debriefed and thank for the job well done after taking the Abaninik psycho-neurological Manual Dexterity Test.

All procedures contributing to this work comply with the ethical standards of Nigeria and institutional committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. All participants provided a written consent before the commencement of the project research.

Inclusion Criteria

1. Participants who have worked in these companies or factories for at least two (2) years were recruited for this project research.
2. Participants within the age range of 20 to 60 years included for this project research.
3. The participants in this research project are low cadre company or factory workers.

Exclusion Criteria

- Participants who have worked in these factories or companies for less than two years were excluded from this project research.
- Participants who were below 20 years or above 60 years were also excluded from this project research.
- High cadre company or factory workers are excluded in this research project.

Instrument:

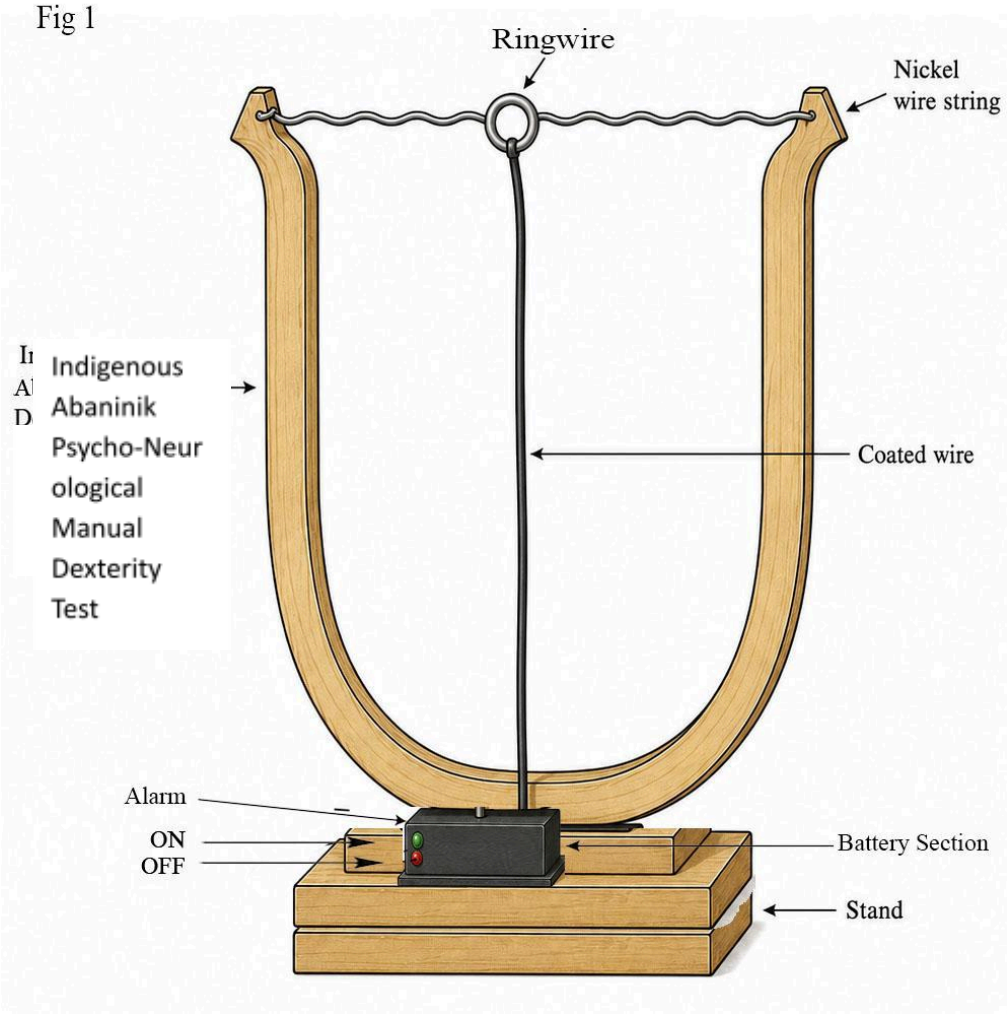
The researchers constructed a psycho-neurological manual dexterity test called Abaninik Psycho-Neurological manual dexterity Test (an indigenous manual dexterity test) that was utilized to assess and test the early signs of neurological disorders in clients or patients. The manual dexterity test was also utilized in the selection and placement of factory or company workers where they have the comparative advantage to perform satisfactorily. It could be used to select factory or company workers who works predominantly with their hands. The instrument was designed in the bow-shape format, with a standing base that has a battery unit and an off switch. It has a wire string from one end of the bow arc to another, and a small circle of wire connected to a long wire that is attached to the battery based semi-conductor device.

Procedure:

The researchers constructed an indigenous manual dexterity text that was named Abaninik Psycho-neurological Manual Dexterity, (ABANINIK) is an acronym for the names of the Authors of this project. The Manual dexterity test composed of a bow-shaped or ark with an aluminum insulator that rested on a stand harboring a battery unit/device that has an on-and-off switch. The bow has an electrical conducted wire from one end to another; the wire is basically to send alarm signals at the touch of a round ring wire that has a coated wire connected to the battery unit. This manual dexterity device, was fabricated to detect the early signs of neurological breakdown (Parkinson's disease) in patients. It is also useful in the selection and placement of workers in the factories and companies, more especially the workers who work with their hands in factories such as wire cables production, textile companies, pharmaceuticals, and bottling companies. The researchers employed the services of an electrical technologist to assist in wiring and connecting the electrical devices of the new manual dexterity test.

The drawing prototype of the manual dexterity test is shown below in Fig 1.

Fig 1



Interpretation

Abaninik Psycho-Neurological Manual Dexterity Test (An Indigenous Manual Dexterity Test), was developed by Abamara et al (2026). It was fabricated in a bow arc like proto-type polished wood on a two-step wooden stand. It has a nickel wire string that stretches from one corner of the arc to another, with a naked ring wire around the nickel wire string. The naked ring wire has an extended coated wire connected to an electrical device attached to the stand base of the arc. The electrical device on the arc contains battery cells that power the manual dexterity test with on/off switch indicators. The nickel wire string from one end of the arc to the other is about two feet wide, and when the device is on, the testees are supposed to move the wire meticulously from one end to the other. Any touch within the circumference of the ring wire will trigger the alarm, indicating that the testees have defaulted. The number of touches that triggers the alarm shows how many times the testees have failed while moving the ring wire across the naked nickel wire. The first-order touches by the testees are designated as excellent performance; the second-order touches by the testees are designated as above average performance; the third-order touches by the testees are designated as average performance; the fourth-order touches by the testees are designated as below average performance; and finally, the fifth-order

touches by the testees are designated as very poor performance. The dimensions of the bow-like arc prototype Abanink psycho-neurological manual dexterity test are 2 feet in height, two feet from one end of the arc to another, with 2 feet of coated wire that terminates at the ring wire that connects to the 3 inches semi-conductor electrical device. The two-step stand is a rectangular 1-foot stand.

Objectives of the Manual Dexterity Test

The Abaninik Psycho-neurological Manual Dexterity Test (APDMT) is designed to screen workers in factories or companies such as bottling companies, pharmaceutical companies, bottle water companies and beverages companies who can competently work with their hands at an appreciable speed. It is specially designed to screen and place workers who work in the corking section of the factories or in the factory section of the company, where they use simple machines to cork bottled drinks or water, or cork bottles or plastics containing pharmaceutical drugs. The Abaninik Psycho-neurological Manual Dexterity test was also designed to screen patients or clients who have the risk of developing Parkinsonism or neural breakdown at the early and adult age of their life.

Design/Statistics

The study (project) will adopt between subjects and independent group designs. A statistical tool of One-way ANOVA and T-test of independent measures was employed to manage the data responses of the participants of this research.

Reliability, Validity and Norms for Categorization

The pilot study of 120 participants was conducted, and the result of the test-retest reliability coefficient stood at .92. For the validity, the researchers adopted face validity for the new Abaninik Psycho-neurological manual dexterity test. The new manual dexterity instrument was sent to manual dexterity experts in six Universities within the country for practical assessment, and they verified and found out that the new manual dexterity test was superficially measuring what it was constructed to measure.

The norm for categorization was determined by a pilot study that was conducted with one hundred and twenty (120) participants drawn from a coca cola bootling Company in Aba, Abia State other than the capital cities of the Southeast states that was used for the main study. The norms obtained from the pilot study was used to determine the performance of the participants in the manual dexterity test. The performance of the participants in the pilot study was also used to determine the performance categorization of the testees of the new Abaninik Psycho-Neurological manual dexterity test. The categorization was designated as excellent performance, above average performance, average performance, below average performance, and very poor performance. This was basically to determine the reliability and validity of the new manual dexterity test that was named ABANINIK Psycho-neurological manual dexterity test. The norm for selection for excellent performance stood at 2.5. The norm for selection for above average performance stood at 4.5. The norm for selection for average performance stood at 6.5. The norm for selection for below average performance stood at 8.5, and finally the norm for selection for very poor performance stood at 10.5.

Table 1: The Mean and Standard Deviation of the main Score of Abaninik Psycho-neurological Manual Dexterity Test (An indigenous Manual Dexterity Test) in Five Compartments

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Gender	80	1.00	2.00	1.4500	.50063
ExcellentPerf	80	1.00	3.00	1.9500	.79396
AboveAveragePerf	80	3.00	6.00	4.3500	1.05662
AveragePerf	80	3.00	7.00	5.2250	1.10207
BelowAveragePerf	80	5.00	9.00	6.9000	1.18642
VeryPoorPerf	80	7.00	10.00	8.6125	.93448
AbaninikManualDexterityTest	80	1.00	10.00	5.5000	2.89040
Valid N (listwise)	80				

The table 1 above shows the descriptive means and standard deviations of five compartments of excellent performance, above average performance, average performance, below average performance and very poor performance on Abaninik Psycho-Neurological Manual dexterity test.

Table 2: One-Way Analysis of Variance (ANOVA) of the main Scores of Abaninik Psycho-neurological Manual Dexterity Test (An Indigenous Manual Dexterity Test) in Five Compartments

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	1.300	9	.144	.547	.835
	Within Groups	18.500	70	.264		
	Total	19.800	79			
ExcellentPerf	Between Groups	8.050	9	.894	1.500	.165
	Within Groups	41.750	70	.596		
	Total	49.800	79			
AboveAveragePerf	Between Groups	7.450	9	.828	.718	.691
	Within Groups	80.750	70	1.154		
	Total	88.200	79			
AveragePerf	Between Groups	8.200	9	.911	.727	.683
	Within Groups	87.750	70	1.254		
	Total	95.950	79			
BelowAveragePerf	Between Groups	10.950	9	1.217	.850	.574
	Within Groups	100.250	70	1.432		
	Total	111.200	79			
VeryPoorPerf	Between Groups	4.862	9	.540	.590	.801
	Within Groups	64.125	70	.916		

	Total	**68.988**	**79**			

Findings:
The result shows no significant gender (male and female difference at F (9, 79) =.547; P .835 in the performance of the Abaninik Psycho-Neurological Manual Dexterity test.
The result shows no significant difference in excellent performance among participants that fall within this category. F (9,79) =1.500; P.165.

The result shows no significant difference in above-average performance among participants that fall within this category. F (9, 79) =.718; P.691.

The result shows no significant difference in average performance among participants that fall within this category. F (9,79) =.727; P.683

The results show no significant difference in below-average performance among participants who fall within this category. F (9,79) = .850; P.574.
The result shows no significant difference in very poor performance among participants who fall within this category. F (9,79) = .590; P.801.

The result

Table 3: T-Test of Independent Samples Showing the Contributions of Gender in five Compartment of Abaninik Psycho-neurological Manual Dexterity Test (An Indigenous Manual Dexterity Test)

Group Statistics

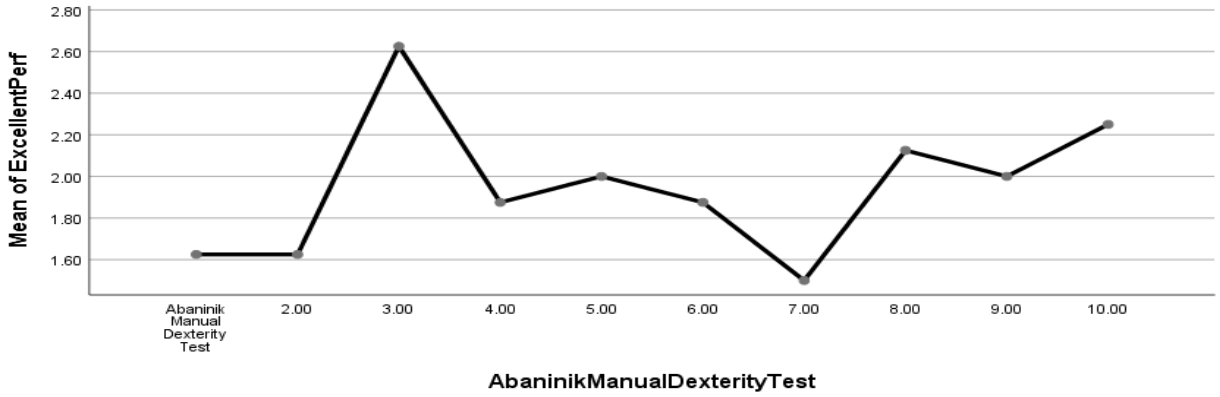
	Gender	N	Mean	Std. Deviation	Std. Error Mean
ExcellentPerf	**Male**	**44**	**1.9545**	**.77623**	**.11702**
	Female	**36**	**1.9444**	**.82616**	**.13769**
AboveAveragePerf	**Male**	**44**	**4.4318**	**1.06526**	**.16059**
	Female	**36**	**4.2500**	**1.05221**	**.17537**
AveragePerf	**Male**	**44**	**5.2955**	**1.04725**	**.15788**
	Female	**36**	**5.1389**	**1.17480**	**.19580**
BelowAveragePerf	**Male**	**44**	**6.8636**	**1.13283**	**.17078**
	Female	**36**	**6.9444**	**1.26366**	**.21061**
VeryPoorPerf	**Male**	**44**	**8.6818**	**.85651**	**.12912**
	Female	**36**	**8.5278**	**1.02779**	**.17130**
AbaninikManualDexterityTest	**Male**	**44**	**5.4773**	**2.97656**	**.44873**
	Female	**36**	**5.5278**	**2.82323**	**.47054**

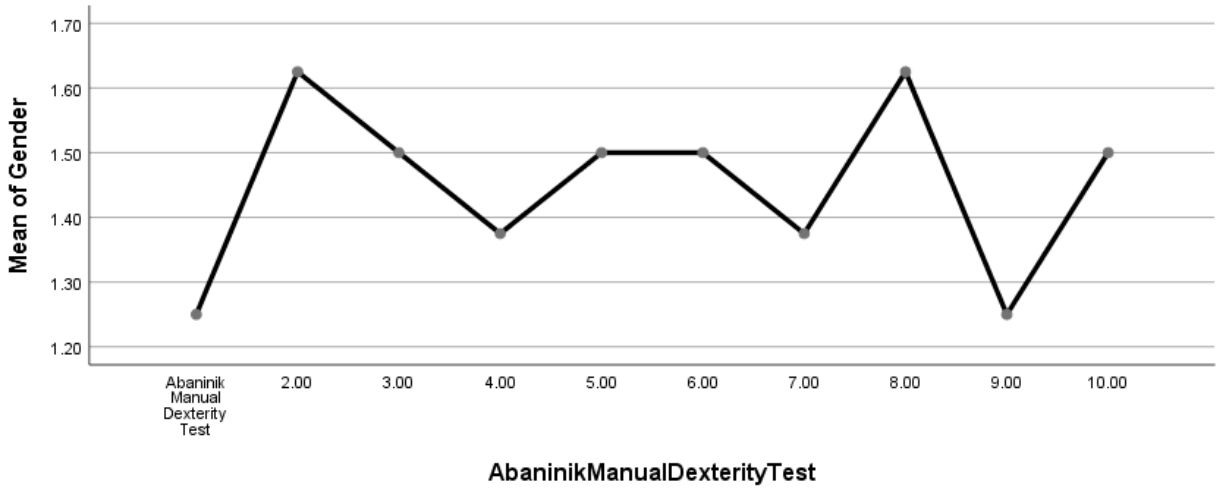
The result in Table 3 shows that female participants performed better than males in the excellent performance category of the Abaninik Psycho-Neurological Manual Dexterity test. (Mean: Male=1.9545, Female=1.9444).
The female participants performed better than male participants in the above-average performance category of the Abaninik Psycho-Neurological Manual Dexterity test. (Mean: Male=4.4318, Female= 4.2500).
The female participants performed better than male participants in the average performance category of the Abaninik Psycho-Neurological Manual Dexterity test. (Mean: Male: 5.2955, Female: 5.1389).

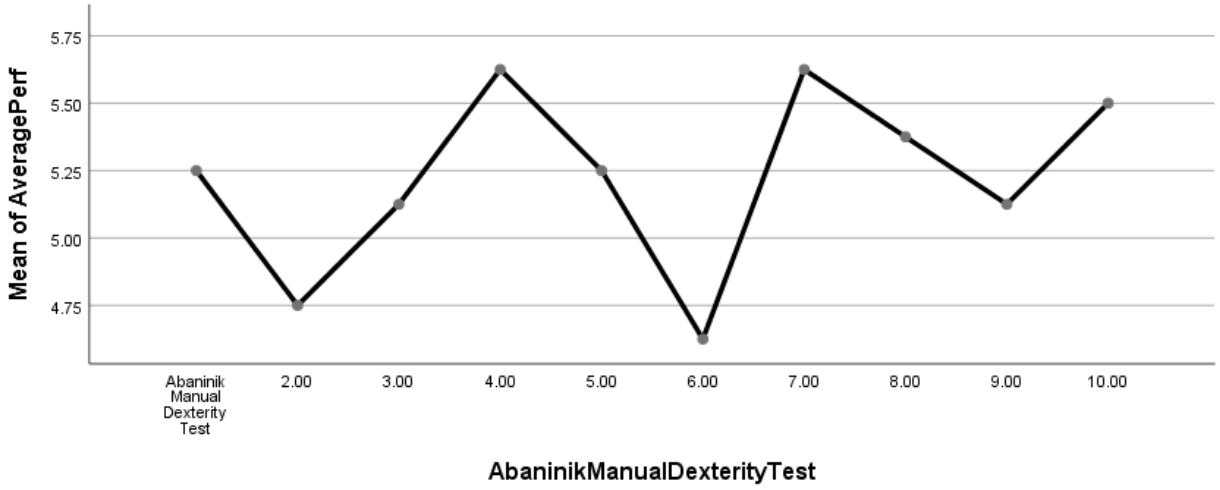
The male participants performed better than female participants in the below-average performance category of the Abaninik Psycho-Neurological Manual Dexterity test. (Mean: Male: 6.8636, Female: =6.9444).

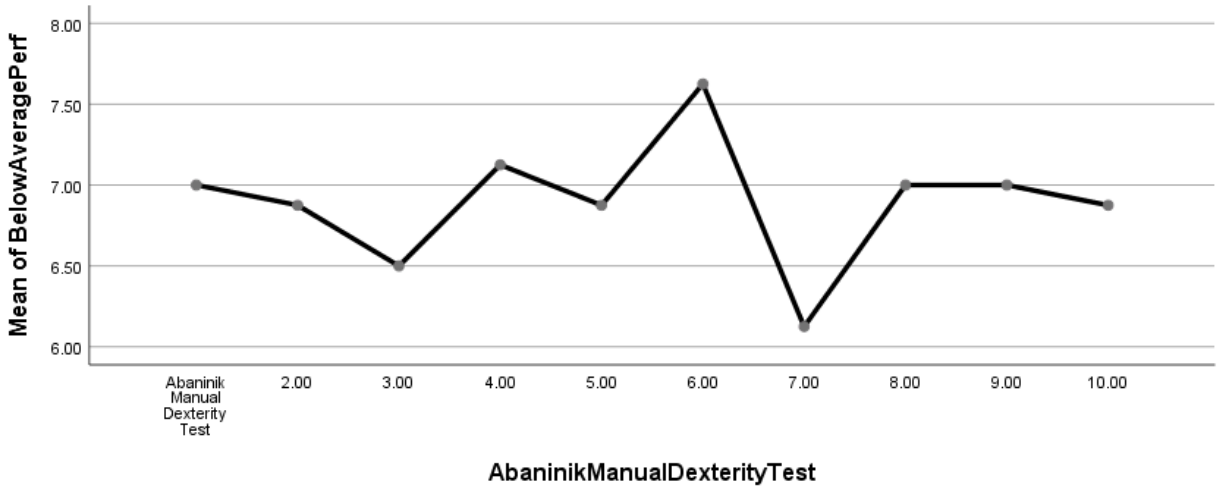
Finally, female participants performed better than male participants in the very poor performance category of the Abaninik Psycho-Neurological Manual Dexterity test. (Mean: Male: 8.8813, Female: 8.5278).
In overall performance, female performed better than male participants in Abaninik Psycho-neurological Manual Dexterity test with the standard error mean for male= .44873 and the standard error mean for female =.47054.

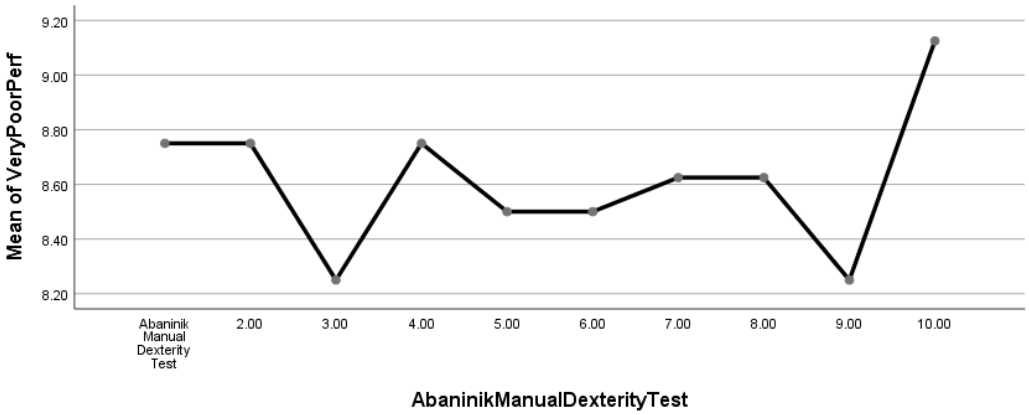
Fig: 2: Graphs on five compartments of excellent performance, above average performance, average performance, below average performance and very poor performance on Abaninik Psycho-Neurological Manual dexterity test.




Mean of Gender
1.70
1.60
1.50
1.40
1.30
1.20
Abaninik Manual Dexterity Test
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
AbaninikManualDexterityTest


Mean of AveragePerf
5.75
5.50
5.25
5.00
4.75
Abaninik Manual Dexterity Test
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
AbaninikManualDexterityTest





DISCUSSION

Abaninik Psycho-neurological Manual Dexterity Test (an indigenous manual dexterity test) was fabricated, developed, validated, and standardized using samples from the main population drawn from five factories/companies in three capital cities of eastern Nigeria.

The results of the project in the first hypothesis of the main population shows that there is no significant difference in the performance of the Abaninik psycho-neurological manual dexterity test across genders. The ANOVA result also shows that there is no significant difference across the compartment of five categories of excellent performance, above average performance, average performance, below average performance, and very poor performance. The independent-samples t-test shows that female participants performed better than male participants across the five mean compartments of excellent performance, above average performance, average performance, below average performance, and very poor performance. The normative and clinical studies establish that women consistently outperform men on task requiring the motor skills, small object manipulation, and rapid finger dexterity (Mathiowetz et al., 1985; Pavlinac Dodig et al., 2020). For example, standardized normative testing on the Nine-Hole Peg Test showed that female participants completed tasks significantly faster than male participants across diverse age groups (Mathiowetz et al., 1985). It is also evident that evaluation across multiple dexterity assessments demonstrates that while men often demonstrate greater whole-hand grip strength, women outperform men on tests requiring precise coordination, such as placing pins on the Purdue Pegboard Test (Wunderle et al., 2024).

Analysis of fine motor precision tasks indicates that sex-related differences in dexterity remain consistent across visual and non-visual feedback conditions, with females showing advantages in fine motor precision and guidance tasks across different age groups (Liutsko et al., 2020). Physiological studies analyzing motor performance report distinct sensorimotor strategies between genders, including differences in muscle activation and movement patterns when performing sustained manual dexterity tasks (Minn & Cote, 2018). The result further shows in hypothesis two that there is no significant difference in performance of participants that had excellent performance, but the result in this category shows that 50 participants recorded excellent performance in the Abaninik psycho-neurological manual dexterity test.
There is no significant difference between participants who recorded above-average performance in the Abaninik psycho-neurological manual dexterity test, a total of 88 participants scored above-average in the new manual dexterity test.

There is no significant difference among participants who recorded average performance in the Abaninik psycho-neurological manual dexterity test, but a total of 96 participants scored on average on the new manual dexterity test. There is no significant difference among participants who recorded below-average performance in the Abaninik psycho-neurological manual dexterity test, but a total of 79 participants scored below average in the performance of the new manual dexterity test.

Finally, there is no significant difference among participants who recorded very poor performance in the Abaninik psycho-neurological manual dexterity test, but a total of 69 participants recorded poor performance in the new manual dexterity test.

The overall, result shows no significant performance of participants across the above five compartments. The findings are in line with the argument that standardized evaluation frameworks applied in the assessment of participant performance in Abaninik psycho-neurological manual dexterity test showed statistical equivalent across categorized groups. Studies in performance analysis and assessment indicate that when tasks are standardized or when participants possess similar baseline training, variance between artificially divided performance tiers from a “very poor” to “excellent” fails to reach statistical significance. This lack of variance suggests that categorized performance distinction may reflect subjective

grading boundaries rather than meaningful differences in underlying capability (Schmidt & Hunter, 2025; Williams et al., 2021). Furthermore, recent empirical evaluation of participants demonstrates that post-hoc performance stratification often yields p-values above the standard significant threshold, conforming no significant main effect across performance categories (Chen & Liu, 2023). In overall female participants performed better than male participants in the Abaninik psycho-neurological manual dexterity test and this stems from the standard error mean difference which shows the mean error of female participant are less than the mean error of male participants.

Recommendations

1. It is recommended that further empirical studies be conducted to establish the reliability and validity of the New Abaninik Psycho-neurological Manual Dexterity Test. Future studies should examine test–retest reliability, inter-rater reliability, and other appropriate reliability indices. Evidence of content, construct, criterion-related, and predictive validity should also be established to determine the extent to which the test accurately measures manual dexterity and associated psycho-neurological functioning.

2. There is a need to develop extensive normative data for the New Abaninik psycho-neurological Manual Dexterity Test using larger and more representative samples. Norms should, where appropriate, take account of variables such as age, sex, educational background, occupational experience, and geographical location. This would make interpretation of individual test scores more accurate and would improve the usefulness of the instrument among different Nigerian populations.

3.Relevant professionals should be adequately trained in the administration, scoring, and interpretation of the New Abaninik Psycho-neurological Manual Dexterity Test. A detailed administration and scoring manual should be developed to ensure that the test is administered under standardized conditions. This will help minimize examiner-related errors and improve consistency in the use of the instrument across different clinical, educational, and research settings.

4.The test should be further investigated for application in clinical psychology, neuropsychology, occupational therapy, rehabilitation, educational assessment, and related areas. Researchers and practitioners should explore its usefulness in assessing manual dexterity among individuals with neurological or neuropsychological difficulties, as well as in monitoring changes in performance during rehabilitation and intervention. Such applications would provide additional evidence concerning the practical value of the indigenous instrument.

5.The New Abaninik Psycho-neurological Manual Dexterity Test should be subjected to continuous research, review, and refinement. Feedback from psychologists, neuropsychologists, occupational therapists, researchers, and other trained users should be considered in improving the test contents, instructions, scoring procedures, and administration process. Further research should also examine its applicability across different Nigerian cultural and linguistic groups and determine whether the instrument remains sensitive, practical, and culturally appropriate as its use expands globally.

Conflict of Interest:

The authors hereby declare that there is no conflict of interest.

Data Availability Statement: The data supporting this study will be provided by the authors upon request.

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