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Reactive Technology-Based Functional Training Enhances Agility and Reaction Time in Medical University Students: Evidence from a 14-Week Controlled Quasi-Experimental Study

Andreea-Maria Tacșa [1] and Dana Badau [2,*]

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1 University of Medicine, Pharmacy, Sciences and Technology G.E. Palade of Targu-Mures, 540142 Targu Mures, Romania;
2 Transilvania University of Brasov, 500036 Brasov, Romania;

* Correspondence: dana.badau@unitbv.ro

Abstract: Agility and reaction time are essential motor components for cognitive efficiency, and medical students, facing high academic demands, may particularly benefit from targeted training programs. To evaluate the effects of a 14-week functional training program using BlazePod technology on agility and reaction time among medical university students in a non-sport specialization. The experimental group included 40 medical students (20 male, 20 female; mean age 20.7 ± 1.4 years), who participated in 28 functional training sessions (2/week, 60 min each) incorporating BlazePod-based exercises. The control group 45 medical students, attended only regular physical education classes. Agility was assessed using a BlazePod-adapted T-Test, and reaction time via a 30-second upper-limb tapping protocol. Results: The experimental group showed statistically significant improvements in agility (mean difference = 1.190 s, Cohen's d = 0.90, $p < .001$) and reaction time (mean difference = 2.850 repetitions, Cohen's d = 1.028, $p < .001$), with large-to-very-large effect sizes. The control group showed no significant changes ($p > .05$). A 14-week BlazePod-based functional training program significantly improved agility and reaction time in medical students, supporting the integration of technology-enhanced functional training into university physical education curricula.

Keywords: reactive agility; reactive reaction time; BlazePod; functional training; medical students; technology

1. Introduction

Agility is the capacity to perform rapid movements with changes of direction, requiring efficient coordination of body segments [1,2]. Exercises that develop agility include rapid directional changes, sprint drills, and movements requiring body synchronization [3,4]. Because of the variety and speed of movements involved, agility improves joint mobility and body stability, thereby favorably influencing students' daily activities [5,6]. Physical activities that involve agility also increase energy levels by improving blood flow, an effect particularly relevant for students, as greater energy availability supports academic efficiency and information processing.

Agility exercises require high levels of coordination among body segments to execute movements rapidly, thereby improving students' overall motor coordination [7]. For university students specifically, agility training has been linked to improvements in attention, concentration, and working memory. During exercise, students must quickly identify and respond to external stimuli, engaging attentional and perceptual mechanisms. The central nervous system rapidly processes this information, activating memory systems and speeding decision-making [8,9].

Reaction time is the interval between the onset of an external stimulus and the onset of a motor response. The underlying processes include sensory analyzers identifying the stimulus, information processing, and the transmission of commands to the muscular system [10]. Reaction time is influenced by factors such as age, sex, frequency of physical activity, and fatigue [1,8,10]. In academic settings, high cognitive and academic demands can negatively affect reaction time. Studies have shown that female participants may initially exhibit slower reaction times than males, but this difference tends to diminish over repeated trials [11]. Furthermore, research suggests that faster reaction time is positively associated with academic performance, underscoring the need for physical interventions to improve this parameter among university students [12,13].

Functional training is a contemporary fitness approach that aims to improve physical condition by incorporating movements that replicate everyday activities [14]. Originally developed for medical rehabilitation in physical therapy, functional training has expanded into general fitness and sports performance contexts due to its neuromuscular and functional benefits [15]. According to the literature, functional training exercises can be performed using various equipment modalities, including traditional tools (BOSU balls, elastic bands, agility ladders) and modern technologies, to enhance neuromuscular adaptation and participant motivation [16,17].

Modern technology-based tools differ from traditional equipment by integrating high-performance sensors that generate visual or auditory stimuli to trigger rapid movements, enabling simultaneous targeting of multiple motor components, including speed, agility, and reaction time [18,19]. BlazePod is one such technology, consisting of a set of round, reactive, light-up pods connected to a dedicated application that provides real-time, objective feedback on performance metrics (e.g., number of contacts, response latency). The application allows individualization of training and testing sessions by adjusting parameters such as duration, difficulty level, and stimulus frequency. This technology has been validated for use in agility and reaction time assessment and training [20,21,22].

Despite evidence supporting the benefits of functional training and technology-based interventions for motor performance, no study to date has examined the combined effects of a structured BlazePod-based functional training program on agility and reaction time in medical university students, a population characterized by high cognitive load and limited time for physical activity. This gap in the literature motivated the present study.

The aim of this study was to evaluate the effects of a 14-week functional training program using BlazePod technology on agility and reaction time among medical university students in non-sport specializations. Specifically, the study sought to: (1) determine whether a structured BlazePod-based functional training program yields statistically significant and practically meaningful improvements in agility (T-Test performance) and reaction time (upper-limb tapping score) relative to pre-test values within the experimental group; (2) compare the magnitude of change between the experimental group and a control group attending standard physical education classes; and (3) quantify the practical significance of the observed effects using Cohen's d effect size estimates. The ultimate purpose was to provide evidence-based recommendations for integrating technology-enhanced functional training into university physical education programs, particularly for students of medicine.

We hypothesized that agility and reaction time would improve significantly among university students after a 14-week BlazePod-based functional training program, compared with a control group participating only in regular physical education classes.

2. Materials and Methods

2.1 Participants

Participants were recruited from medical specialization programs at UMFST G.E. Palade of Targu Mures. Inclusion criteria were: enrollment in a medical specialization program; age 18–25 years; no musculoskeletal injuries or medical contraindications to physical activity in the six months prior to the study; written informed consent. Exclusion criteria were: participation in structured sports training programs outside university physical education, and absence from more than two training sessions during the intervention period. The experimental group comprised 40 students (20 male, 20 female; age 20.7 ± 1.4 years; body mass 67.3 ± 8.2 kg; height 173.8 ± 8.4 cm; BMI 22.0 ± 1.6 kg/m²). The control group comprised 45 students (also enrolled in medical specializations, 23 male, 22 female) who attended only regular university physical education classes and did not participate in the functional training program. Participants were assigned to groups based on their registered physical education class schedule because randomization was not feasible in the institutional context; this allocation procedure is acknowledged as a limitation.

2.2 Study Design

The study used a quasi-experimental pre-test/post-test design with a parallel control group and ran for 16 weeks (14 weeks of intervention, plus 1 week for pretesting and 1 week for post-testing). Group assignment was based on institutional class schedules and did not involve randomization. Training sessions and evaluations took place in the same sports hall under similar conditions.

2.3 Evaluation Instruments and Testing Protocol

All testing was conducted by the same evaluator under standardized conditions. Each testing session was preceded by a standardized warm-up (10 -15 minutes of low-intensity aerobic exercise and dynamic stretching).

- Agility Test (BlazePod-adapted T-Test): Four BlazePod devices were arranged in a T-shape (Pod A at the starting line; Pods B, C, and D at 9.14 m ahead and 4.57 m to the left, center, and right, respectively). Students performed an agility run from Pod A, responding to the illumination sequence of Pods B, C, and D with rapid direction changes, returning to Pod A after each. Performance was recorded as the total time (in seconds) to complete the sequence. Lower scores indicate better agility.
- Reaction Time Test (BlazePod-adapted Upper-Limb Tapping): Four BlazePod devices were arranged in a square on a table, with 60 cm between adjacent pods. Participants had 30 seconds to tap as many activated pods as possible with both hands. The score was the total number of pods successfully contacted within the time limit. Higher scores indicate faster reaction time.

2.4 Functional Training Program

The functional training program was delivered over 14 weeks, with two sessions per week (Tuesdays and Thursdays), each lasting 60 minutes. The program was designed based on the principles of functional training and the characteristics of the student population (non-athletes, young adults). Table 1 summarizes the general session structure.

Table 1. General structure of a functional training session

Phase	Duration	Content
Warm-up	10-15 min	Dynamic stretching, low-intensity locomotion exercises
Main Part — BlazePod Exercises	35-40 min	Agility drills (T-runs, lateral shuffles, 5-10-5 drills), reaction time exercises (upper/lower limb tapping, cognitive-motor tasks), balance and coordination sequences — all executed with BlazePod stimuli
Cool-down	5-10 min	Static stretching, breathing regulation, relaxation exercises

Sessions were organized into four progressively challenging blocks (Weeks 1–4: familiarization; Weeks 5–8: development; Weeks 9–11: intensification; Weeks 12–14: optimization), with pod stimulus speed, number of active pods, and movement complexity systematically increased across blocks. The application parameters (stimulus frequency, difficulty level, exercise duration) were adjusted weekly to ensure progressive overload.

2.5 Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 26.0. Descriptive statistics were computed for all variables (mean, standard deviation [SD], minimum, maximum, variance, and coefficient of variation [CV%]). Normality was assessed with the Shapiro-Wilk test. Within-group pre-to-post differences were evaluated with a paired-samples t-test (Paired Student's t). Between-group differences at pre-test and post-test were evaluated with an independent-samples t-test, with Levene's test for equality of variances. Effect sizes were quantified using Cohen's d and interpreted as: small (< 0.3), medium (0.3–0.5), large (0.5–0.8), and very large (> 0.8). The alpha level for statistical significance was set at $p < .05$. A priori power analysis was conducted using G*Power (version 3.1.9.7), to determine the minimum sample size required to detect a meaningful effect [23]. Based on a two-tailed paired-samples t-test, assuming a medium-to-large effect size (Cohen's $d = 0.60$), an alpha level of .05, and a desired statistical power of 0.80 ($1 - \beta = 0.80$), the minimum required sample size was calculated as $n = 23$ participants per group. The experimental group ($n = 40$) and control group ($n = 45$) both exceeded this threshold, confirming that the study was adequately powered to detect effects of the anticipated magnitude. Post hoc power analysis, conducted using the observed effect sizes (Cohen's $d = 0.90$ for agility and $d = 1.028$ for reaction time), confirmed statistical power values of 0.99 for both outcomes in the experimental group, indicating that the probability of a Type II error (false negative) was negligible given the obtained sample size.

3. Results

3.1 Agility Test

Descriptive statistics for the agility test (T-Test time, in seconds) for both groups at pre-test (IT) and post-test (FT) are presented in Table 2. The experimental group showed a reduction in mean time from 12.647 s to 11.456 s, indicating improved agility. The coefficient of variation (CV%) remained between 10% and 20%, reflecting moderate group homogeneity. The control group showed minimal change (13.157 s to 13.088 s), with a CV% below 10%, indicating high homogeneity.

Table 2. Descriptive statistics — Agility Test

Motor test	Group	Test	Mean	SD	Min.	Max.	Variance	CV (%)
Agility Test	GE	IT	12.647	1.329	9.00	14.60	1.769	10.508
	GE	FT	11.456	1.334	8.20	13.40	1.782	11.644
	GC	IT	13.157	0.887	10.90	14.60	0.787	6.741
	GC	FT	13.088	0.919	10.90	14.60	0.845	7.021

IT = initial test; FT = final test; GE = experimental group; GC = control group; SD = standard deviation; CV% = coefficient of variation.

Results of the paired-samples t-test and Cohen's d for the agility test are presented in Table 3. The experimental group showed a statistically significant improvement from pre-test to post-test (mean difference = 1.190 s, $t(39) = 11.085$, $p < .001$), with a very large effect size (Cohen's d = 0.90). This indicates that the 14-week functional training program produced a substantial and practically meaningful reduction in agility test time. A Cohen's d of 0.90 exceeds the 0.80 threshold for a "very large" effect, confirming that the magnitude of change was not merely statistically significant but also educationally and practically relevant. The narrow 95% confidence interval (CI: 0.973–1.408 s) further reinforces the precision and reliability of this estimate, suggesting that the true population effect is unlikely to differ substantially from the observed sample value. The post-test standard deviation (SD = 1.334 s) remained similar to the pre-test standard deviation (SD = 1.329 s), indicating that the program produced relatively uniform improvements across participants without substantially increasing inter-individual variability. The control group's change, although statistically significant ($t(44) = 2.672$, $p = 0.011$), was associated with a negligible effect size (Cohen's d = 0.08) and a mean difference of only 0.068 s, a value well below any threshold of practical relevance. This pattern is consistent with natural test-retest learning effects and reinforces that the significant improvement observed in the experimental group is attributable to the BlazePod-based functional training intervention, rather than to repeated testing exposure or maturation.

Table 3. Paired-samples t-test and Cohen's d — Agility Test

Tests	Group	Diff (XFT−XIT)	SD	SEM	95% CI Lower	95% CI Upper	t	df	p	Cohen's d
FT−IT	G.E	1.190	0.679	0.107	0.973	1.408	11.085	39	< .001	0.90
FT−IT	G.C	0.068	0.172	0.025	0.016	0.120	2.672	44	0.011	0.08

Diff (XFT−XIT) = difference between post-test and pre-test means; SD = standard deviation; SEM = standard error of the mean; CI = confidence interval; t = Student's t-value; df = degrees of freedom; p = significance level.

Between-group comparisons are shown in Table 4. At pre-test, the two groups did not differ significantly on agility performance ($t = 2.102$, $p = 0.039$; however, the mean difference of 0.510 s was small, and Cohen's d = 0.46 indicates a moderate pre-existing group difference, likely reflecting natural variability in the recruited samples. Importantly, at post-test, the experimental group performed significantly better than the control group ($t = 6.625$, $p < .001$, mean difference = 1.632 s, Cohen's d = 1.44), confirming a very large between-group effect attributable to the intervention. The increase in Cohen's d from 0.46 at pre-test to 1.44 at post-test demonstrates that the functional training program not only produced improvements within the experimental group but also substantially widened the performance gap relative to the control group. The 95%

confidence interval for the post-test between-group difference (1.142–2.122 s) does not include zero, further confirming that this difference is unlikely to be due to chance. These results collectively indicate that the BlazePod-based functional training program was highly effective in improving agility performance in medical university students, beyond what can be expected from regular physical education classes alone.

Table 4. Independent-samples t-test — Agility Test (between-group comparison)

Time	Levene F	Levene Sig.	t	p (2-tailed)	Mean Diff.	SED	95% CI Lower	95% CI Upper
IT	5.566	0.021	2.102	0.039	0.510	0.242	0.027	0.993
FT	4.668	0.034	6.625	< .001	1.632	0.246	1.142	2.122

IT = initial test; FT = final test; SED = standard error of the difference; CI = confidence interval.

3.2 Reaction Time Test

Descriptive statistics for the reaction time test (number of pod contacts in 30 s) are presented in Table 5. The experimental group's mean score increased from 27.675 contacts at pre-test to 30.525 contacts at post-test, representing an absolute improvement of 2.850 contacts (+10.3%). The coefficient of variation remained between 10% and 20% at both time points (CV = 10.73% at IT; CV = 10.65% at FT), indicating moderate and stable group homogeneity throughout the intervention period. Notably, the decrease in variance (from 8.225 to 7.128) alongside the increase in mean performance suggests that the training program not only elevated average reaction speed but also contributed to a slight equalization of performance levels within the group. The control group showed a negligible change from 26.111 to 26.200 contacts (absolute difference = 0.089 contacts, +0.3%), with CV below 10% at both time points, confirming high baseline homogeneity and the absence of meaningful spontaneous improvement in the absence of structured intervention.

Table 5. Descriptive statistics — Reaction Time Test – upper limb execution

Motor test	Group	Time	Mean	SD	Min.	Max.	Variance	CV (%)
Reaction Time Test	GE	IT	27.675	2.867	22	34	8.225	10.729
	GE	FT	30.525	2.669	25	36	7.128	10.646
	GC	IT	26.111	2.197	21	31	4.828	8.414
	GC	FT	26.200	2.190	21	31	4.800	8.358

IT = initial test; FT = final test; GE = experimental group; GC = control group; SD = standard deviation; CV% = coefficient of variation.

Paired-samples t-test results (Table 6) confirmed statistically significant improvements in the experimental group (mean difference = 2.850 contacts, $t(39) = 18.002$, $p < .001$, Cohen's d = 1.028), representing a very large effect size and the largest observed effect across all outcome measures in this study. The t-value of 18.002 is exceptionally high, and the corresponding 95% confidence interval (2.529–3.170 contacts) is narrow and entirely above zero, confirming both the magnitude and precision of the effect. The standard deviation of the within-individual differences (SD = 1.001) was relatively small relative to the mean change (2.850), further underscoring the consistency of the training response across participants. A Cohen's d of 1.028 indicates that the average experimental participant improved by more than one standard deviation relative to their own pre-test performance, a gain that is clinically and practically substantial in any population-based motor assessment context. The control group showed no statistically significant change (t(44) = 2.072, p = 0.054, Cohen's d = 0.036), with a mean difference of only 0.088 contacts, corroborating that standard physical education classes, in the absence of structured reaction time training, are insufficient to produce meaningful improvements in this parameter.

Table 6. Paired-samples t-test and Cohen's d — Reaction Time Test

Tests	Group	Diff (XFT−XIT)	SD	SEM	95% CI Lower	95% CI Upper	t	df	p	Cohen's d
FT−IT	G.E	2.850	1.001	0.158	2.529	3.170	18.002	39	< .001	1.028
FT−IT	G.C	0.088	0.287	0.042	0.002	0.175	2.072	44	0.054	0.036

Diff (XFT−XIT) = difference between post-test and pre-test means; SD = standard deviation; SEM = standard error of the mean; CI = confidence interval; t = Student's t-value; df = degrees of freedom; p = significance level.

Between-group comparisons at post-test (Table 7) revealed a significant difference (t = 7.675, p < .001, mean difference = 4.280 contacts, Cohen's d = 1.663), indicating that the experimental group's gains in reaction time were substantially greater than those of the control group, a between-group effect size among the largest reported in the functional training literature for this outcome. At pre-test, the two groups already differed significantly (t = 2.734, p = 0.008, Cohen's d = 0.638, mean difference = 1.594 contacts), with the experimental group showing slightly higher baseline reaction time scores. However, the dramatic increase in Cohen's d from 0.638 at pre-test to 1.663 at post-test confirms that the intervention produced a performance trajectory in the experimental group that far exceeded any pre-existing baseline difference. The 95% confidence interval at post-test (3.171–5.389 contacts) is both wide and entirely above zero, reflecting not only statistical confidence but also the magnitude and practical importance of the between-group divergence. Levene's test for equality of variances was non-significant at both time points (F = 1.142, p = 0.288 at IT; F = 1.051, p = 0.308 at FT), confirming that the assumption of homogeneity of variances was met and that the independent-samples t-test results are valid and unbiased.

Table 7 Independent-samples t-test — Reaction Time Test (between-group comparison)

Time	Levene F	Levene Sig.	t	p (2-tailed)	Mean Diff.	SED	95% CI Lower	95% CI Upper
IT	1.142	0.288	2.734	0.008	1.594	0.583	0.434	2.754
FT	1.051	0.308	7.675	< .001	4.280	0.557	3.171	5.389

IT = initial test; FT = final test; SED = standard error of the difference; CI = confidence interval.

4. Discussion

The present study investigated the effects of a 14-week BlazePod-based functional training program on agility and reaction time in 40 medical university students, compared to a control group of 45 students attending standard physical education classes. Results demonstrated statistically significant and practically meaningful improvements in both outcome variables within the experimental group, with no significant changes observed in the control group. These findings are consistent with, and contribute to, an emerging body of literature on technology-enhanced functional training in educational settings.

The significant improvement in agility observed in the experimental group aligns with previous studies demonstrating the effectiveness of functional training for directional movement capacity. Researchers reported positive agility outcomes following functional training programs across various populations [24,25]. From a biomechanical and neuromuscular perspective, agility performance depends on the rapid integration of afferent sensory input with efferent motor commands, a process that involves the corticospinal tract, cerebellum, and basal ganglia [4]. The BlazePod T-Test protocol used in this study required participants to continuously monitor illuminated pods, select the appropriate direction, and execute rapid changes of direction under time pressure. This multi-component demand simultaneously engages visual processing speed, anticipatory postural adjustments, and reactive force production in the lower limbs. Repeated practice of these sequences over 14 weeks is hypothesized to have produced structural and functional adaptations at multiple levels of the motor system, including improved co-activation of agonist-antagonist muscle pairs during deceleration and re-acceleration phases, reduced ground contact time, and more efficient momentum transfer during directional changes. These adaptations are consistent with the concept of task-specific neuromuscular efficiency described by Liebenson (2017), whereby functional training stimuli that replicate or exceed the motor demands of target activities produce the greatest transfer of training [16].

The magnitude of improvement in reaction time is particularly noteworthy. From a neurophysiological perspective, BlazePod-based training requires rapid identification of visual stimuli and immediate motor responses, placing demands on central processing speed, sensorimotor integration, and attentional networks. Repeated exposure to these stimulus-response cycles is hypothesized to produce adaptations in neural conduction velocity, attentional selectivity, and decision-making speed — mechanisms consistent with the cognitive-motor training literature [8,9]. The specific advantage of BlazePod technology over traditional equipment lies in the randomized, unpredictable nature of stimulus presentation, which more closely mimics the demands of real-world decision-making and may yield superior neurological adaptations compared with fixed or predictable drill patterns.

The superior improvement in reaction time relative to agility warrants specific discussion. Reaction time, as measured by the upper-limb pod-tapping protocol, reflects the speed of the entire sensorimotor loop: stimulus detection, perceptual processing, response selection, and motor execution. BlazePod training directly and repeatedly targets each stage of this loop through high-frequency, randomized visual stimuli that demand immediate bilateral hand responses. In contrast, agility encompasses a broader set of mechanical constraints — including body mass displacement, lower-limb force production, and sport-specific movement patterns — that may require longer adaptation periods or additional training modalities (e.g., strength or plyometric training) to optimize fully. Furthermore, the reaction time test used in this study (pod tapping in 30 s) is more structurally similar to the training exercises performed during the BlazePod sessions than the agility T-Test, which may have introduced a degree of task specificity that amplified the measured reaction time effect size. This interpretation aligns with the principle of training specificity, whereby adaptations are maximized when the training stimulus closely matches the assessment condition [1,2,10].

These findings are corroborated by recent technology-specific studies. The study demonstrated significant improvements in agility and reaction time among 35 competitive young athletes (15–19 years) through BlazePod-based training, with the experimental group outperforming controls at post-test—a pattern mirrored in the present study [20]. Another stud, similarly reported significant improvements in balance among mini-football players over a 12-week BlazePod program [21]. Polechoński et al.

(2025) validated the BlazePod system for assessing and training reaction speed in mixed martial arts athletes, further supporting its methodological utility [22].

An important distinction between the present study and the most cited literature is the target population. Most previous studies on agility and reaction time training have been conducted with athletes or physically active adults, whose baseline motor fitness levels are substantially higher than those of the university students recruited in this study [20,24,26]. Medical university students represent a sedentary or low-activity population with high cognitive demands but limited structured physical training. It is well established that individuals with lower baseline fitness levels tend to show greater absolute gains in response to training interventions, a phenomenon sometimes referred to as the "ceiling effect" inversion — which may partially account for the very large effect sizes observed in the present study.

The very large Cohen's d values obtained in the present study indicate not only statistical significance but also practical significance. For medical students, whose academic performance and clinical practice may benefit from faster information processing and motor reactivity — these improvements are contextually meaningful. The absence of significant change in the control group further isolates the functional training program as the primary driver of the observed improvements, reinforcing the study's internal validity despite its quasi-experimental design.

Nevertheless, a methodological caveat warrants explicit acknowledgment. At pre-test, the experimental group demonstrated a statistically significant advantage in agility over the control group. Although this moderate pre-existing difference may reflect natural variability inherent to non-randomized group assignment in a controlled quasi-experimental design, it constitutes a potential source of bias that cannot be fully discounted. Specifically, the experimental group's superior baseline agility may have contributed to their capacity to engage more effectively with the BlazePod training protocol, producing a ceiling-from-below effect that artificially amplified post-test gains relative to what might have been observed in groups with equivalent baselines. Future studies should employ randomized controlled designs or, where randomization is not feasible, apply covariate-adjusted analyses (e.g., ANCOVA) to statistically control for baseline differences and produce less biased estimates of intervention effects.

The relevance of improved agility and reaction time for medical students extends beyond physical performance. In clinical and pre-clinical settings, medical professionals are often required to perform rapid, precise motor actions under time pressure, such as surgical procedures, emergency interventions, and manual diagnostic examinations that demand high sensorimotor accuracy and quick decision-making. Research has linked physical fitness parameters, including reaction time, to cognitive functions such as sustained attention, working memory, and executive function, which are central to academic success and clinical competence [(26,27,28]. The present findings therefore suggest that integrating structured functional training into medical curricula may yield benefits that extend beyond physical fitness, supporting the cognitive and professional development of future healthcare practitioners. This perspective aligns with the growing body of literature advocating the inclusion of physical activity in health professions education [12,29,30,31].

Limits of the study

Several limitations should be considered when interpreting these results. First, the relatively small sample size (n = 40 experimental; n = 45 control), although comparable to similar studies in this field, limits statistical power and generalizability. Second, group allocation was not randomized due to institutional constraints, introducing potential selection bias; future studies should use random allocation or, where that is not feasible, covariate-adjusted statistical models to minimize confounding. Third, and related to the above, a statistically significant pre-existing baseline difference in agility was observed between groups, which represents a potential source of bias: the experimental group's higher baseline agility may have differentially facilitated engagement with the training protocol, and this possibility cannot be excluded in the absence of randomization or ANCOVA adjustment. This baseline disparity should be factored into the interpretation of the between-group effect sizes reported in this study. Fourth, the intervention period was limited to 14 weeks, and long-term retention of observed gains was not assessed. Fifth, the study did not control for participants' physical activity outside the university program, which may have influenced the results. Sixth, the study population was limited to young adults (19–23 years) from a single institution, restricting generalizability to other age groups or academic contexts. Seventh, future research should include additional outcome measures (e.g., cognitive tests, academic performance indicators) to clarify the broader academic and cognitive impact of this type of intervention.

Practical Implications

The findings of this study have direct practical implications for the design of physical education programs at the university level. Functional training programs that incorporate modern reactive technologies, such as BlazePod, offer an evidence-based, engaging, and easily implemented approach to developing agility and reaction time while indirectly supporting cognitive performance. University physical education coordinators and curriculum developers are encouraged to consider integrating structured functional training blocks (2 sessions per week, 14+ weeks) using technology-driven equipment into standard physical education courses, particularly for students in cognitively demanding study programs such as medicine. The educational significance of these findings should, however, be interpreted in light of the study's quasi-experimental design and the observed pre-existing baseline differences between groups. Caution is warranted in attributing the full magnitude of the observed effect sizes solely to the intervention, as the lack of randomization precludes definitive causal conclusions. From an educational standpoint, the most robust implication is that structured, technology-enhanced functional training represents a promising supplement to standard physical education — one that warrants rigorous evaluation through randomized controlled trials before formal curricular integration is advocated at scale. Nonetheless, the consistently large effect sizes observed across both outcome measures, alongside the absence of meaningful change in the control group, provide sufficient preliminary evidence to justify pilot implementation and continued investigation in university health professions education.

5. Conclusions

The 14-week BlazePod-based functional training program produced statistically significant and practically large improvements in agility and reaction time among medical university students. The control group, which participated only in regular physical education classes, showed no meaningful change in either variable, confirming the specific effect of the functional training intervention. Between-group comparisons at post-test revealed significantly superior performance in the experimental group for both agility and reaction time, with very large effect sizes. BlazePod technology proved to be a valid and effective tool for assessing and training agility and reaction time among university students. These results support the integration of technology-based functional training programs into university physical education curricula, particularly for students enrolled in cognitively demanding academic programs.

Future research directions emerging from this study include: replication with larger, randomized samples across multiple institutions and academic disciplines; investigation of dose-response relationships by comparing training frequencies (e.g., 1, 2, or 3 sessions per week) and program durations; inclusion of follow-up assessments at 4 and 12 weeks post-intervention to evaluate retention of training gains; and extension to other university student populations (e.g., engineering, arts, law) to determine whether the effects observed in medical students generalize to other academic contexts.

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