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Plyometric Training And Heart Health In College Women: A Six-Week Study On Cardiovascular Fitness And Body Composition

Dr. Bini A, Assistant Professor, Department of Physical Education,

HHMSPB NSS College for Women, Neeramankara

Abstract: Most college students today spend the bulk of their day sitting in lectures, at desks, or on screens. This lifestyle entails real health costs, and finding effective, uncomplicated ways to exercise is increasingly important. This study looked at how plyometric training exercises, built around explosive, spring-like movements such as jumping and hopping, affect the cardiovascular health and body fat by taking a case study approach of 30 female students at NIT Calicut.

Over six weeks, the students were split into three groups of performing high-intensity plyometrics, low-intensity plyometrics, and as control. Both exercise groups ended the programme with noticeably lower resting heart rates — a reliable sign of a stronger, more efficient heart. Body fat levels, however, did not change significantly, which points to the well-established pattern that cardiovascular fitness improves faster than body composition in short-term programmes.

The takeaway is encouraging: plyometrics requires no equipment, fits easily into a student's schedule, and produces measurable heart health benefits in just six weeks. For a generation of young people whose academic lives are largely sedentary, that is a practical and accessible place to start.

Keywords: **Plyometric Training, Heart Health, Resting Heart Rate, Body Composition**

Introduction

Physical fitness is not just a personal goal; it underpins how well the body's systems function day to day, and it shapes both individual well-being and broader societal productivity. However, in the modern era lifestyle, Sedentary habits have become the norm, especially in academic settings. This shift carries serious consequences. Identifying forms of exercise that are both time-efficient and genuinely effective has become a pressing question in sports science and public health. Among the options available, plyometric training has drawn sustained attention because it bridges strength and speed in a way that few other methods can match.

Plyometric exercise works by exploiting the body's natural ability to store and release energy. During a rapid muscle stretch, the eccentric phase, elastic energy accumulates in the tendons and connective tissue. When this is immediately followed by a powerful shortening contraction, that stored energy is released, producing a stronger and faster movement than the muscles alone could generate. This mechanism, called the stretch-shortening cycle (SSC), is what makes jumping, bounding, and hopping so effective at building explosive power. Though plyometrics has long been associated with elite sport, applying it to everyday college populations, particularly women, opens up an important opportunity to address cardiovascular and metabolic health in a group that is often underrepresented in sports science research.

The scale of the problem is hard to ignore. Physical inactivity is estimated to contribute to around 4.5 million deaths each year in India. For students spending their qualitative years in classrooms and libraries, building movement habits matters significantly. Genetics does play a role in fitness — accounting for roughly 25 to 45 percent of an individual's physical capacity. But behaviour covers the rest. Regular exercise and sensible nutrition can compensate for genetic disadvantages. This is critically relevant for students who are about to lead desk-bound careers in medicine, law, or education, where the temptation to deprioritise physical activity only grows with time.

Theoretical Framework of the Stretch-Shortening Cycle

The science behind plyometric training draws on two complementary models: mechanical and Neurophysical. The mechanical model describes how tendons and connective tissue, collectively called the series elastic component (SEC), behave like a spring under rapid loading. When a muscle is stretched quickly and then immediately contracted, the energy stored during the stretch is returned in the subsequent movement, augmenting the force produced. The key to making this work efficiently lies in the amortisation phase, which is the brief moment between the stretch and the contraction. The shorter this transition, the more elastic energy is preserved. If the pause is too long, that energy dissipates as heat, and the advantage is lost.

The neurophysical model adds another layer. When muscle spindles detect a sudden stretch, they trigger an involuntary reflex that increases motor neuron activity, prompting a stronger contraction. This stretch reflex is a built-in protective mechanism that plyometric training deliberately harnesses. The resulting SSC can be fast with ground contact times under 250 milliseconds, as in sprinting or depth jumps, or slow, involving longer contacts and deeper ranges of motion. Both forms recruit fast-twitch muscle fibres and develop the kind of explosive, coordinated power that benefits athletic performance.

In women, these mechanisms are shaped by some additional biological factors. Females tend to have a higher proportion of slow-twitch (Type I) muscle fibres and different skeletal geometry, including a wider Q-angle at the knee, which can affect how forces are distributed during landing tasks. These differences influence injury risk and may partially explain why women acquire stronger gains in upper-body strength than men following plyometric programmes. All of these points point to the value of designing training protocols that take female physiology into account rather than simply adapting protocols developed for male athletes.

Experimental Methodology and Participant Selection

This study was conducted at the National Institute of Technology (NIT), Calicut, with thirty female resident students aged 18 to 20. This age group is particularly significant because it represents a phase during which the cardiovascular and metabolic baselines are still being established, and habits formed here often persist into adulthood. Participants were randomly segregated into three equal groups of ten: a high-intensity plyometric group, a low-intensity plyometric group, and a control group that maintained normal daily routines without any structured exercise intervention.

Two primary outcomes were tracked: resting heart rate (RHR), measured using the radial wrist pulse test, and body fat percentage, assessed through skinfold measurements. Both are well-recognised markers of cardiovascular and metabolic health. The training ran for six weeks, with three sessions per week on non-consecutive days, allowing 48 to 72 hours of recovery between sessions, which is the standard recommendation from organisations such as the National Strength and Conditioning Association.

Each session lasted 30 to 45 minutes and included a proper warm-up and cool-down to reduce injury risk. The two training groups followed different protocols. When the high-intensity group performed exercises with greater jump heights and faster loading, the low-intensity group focused on higher repetition volumes at lower mechanical stress. The exercises were the same across groups: skipping, hopping, box jumping, and squat jumps. However, the duration, sets, and recovery periods were adjusted according to intensity level. Details are shown in Table 1 below.

Table 1: Plyometric Exercise Protocol by Intensity Group

Sl. No.	Exercise	Low Intensity Group I	High Intensity Group II
1	Skipping	#5 % 4 * 20	#10 % 6 * 30
2	Hopping	#2 % 4 * 20	#5 % 6 * 30
3	Box Jumping	#2 % 4 * 20	#5 % 6 * 30
4	Squat Jump	#2 % 4 * 20	#5 % 6 * 30

*# = minutes, % = repetitions, & = sets, * = recovery period in seconds*

Results and Statistical Analysis

Data were analysed using analysis of covariance (ANCOVA), which adjusts for any initial differences between groups before comparing outcomes. All statistical tests used a confidence level of 0.05, meaning a result was considered significant when the calculated F-ratio exceeded the standard table value. Pre-test scores confirmed that all three groups started from a comparable baseline, which is important for drawing valid conclusions from post-intervention differences.

Cardiovascular Adaptations: Resting Heart Rate

The clearest finding from this study was a significant drop in resting heart rate in both exercise groups. Trained individuals typically develop lower RHR because the heart becomes stronger and more efficient: it pumps more blood with each beat (increased stroke volume), so it needs to beat less often. This shift also reflects a healthier balance in the autonomic nervous system, with the parasympathetic ('rest and digest') side becoming more dominant over the sympathetic ('fight or flight') side.

Table 2: ANCOVA Results for Resting Heart Rate and Fat Percentage

Variables	Test	High Intensity Group	Low Intensity Group	Control Group	F Ratio
Resting Heart Rate	Pre-test	81.200	82.200	84.200	0.5294
	Post-test	77.400	80.600	85.200	**3.4811***
	Adjusted	78.685	80.899	83.616	**14.028***
Fat Percentage	Pre-test	20.041	20.552	20.550	0.283
	Post-test	19.925	20.465	20.806	0.5730
	Adjusted	20.279	20.287	20.630	**3.6792***

** Significant at 0.05 level (table value: df 2 and 27 = 3.35; df 2 and 26 = 3.37)*

The adjusted post-test F-ratio of 14.028 far exceeded the required threshold of 3.37, meaning the improvements in resting heart rate were statistically meaningful, not the result of chance. Scheffe's post-hoc test was then used to identify exactly which group comparisons drove this result.

Table 3: Scheffe's Post-Hoc Test — Resting Heart Rate Paired Mean Differences

Control Group	Experimental Group I	Experimental Group II	Mean Difference	CI Value
83.616	78.685	—	**4.931***	2.379
83.616	—	80.899	**2.717***	2.379
—	78.685	80.899	2.214	2.379

** Significant at 0.05 level of confidence.*

Both the high-intensity group (mean difference: 4.931) and the low-intensity group (mean difference: 2.717) showed significantly lower resting heart rates than the control group. The difference between the two training groups (2.214) did not quite reach the significance threshold of 2.379 — which is actually a reassuring finding. It suggests that the type of plyometric training matters less than simply doing it: either intensity level produced real cardiovascular benefits in these students.

Body Fat Percentage

The body fat results were more nuanced. The raw post-test comparison showed no significant difference between groups, but once ANCOVA was applied to adjust for baseline differences, a statistically significant F-ratio (3.6792) emerged. This hints that the training did begin to influence body composition, but the follow-up Scheffe's test found that no individual group pair differed significantly.

Table 4: Scheffe's Post-Hoc Test — Fat Percentage Paired Mean Differences

Control Group	Experimental Group I	Experimental Group II	Mean Difference	CI Value
20.630	20.279	—	0.351	0.385
20.630	—	20.287	0.343	0.385
—	20.279	20.287	0.008	0.385

** Significant at 0.05 level of confidence.*

This outcome posits the pragmatic side of the methodology adopted. Meaningful reductions in body fat generally require a sustained caloric deficit and consistent training over at least eight to twelve weeks. Therefore, it gives on to the hypothesis that Plyometric training primarily is a tool for neuromuscular power, not for generating the kind of prolonged cardiovascular load associated with fat loss. In lean, relatively young individuals like the NIT Calicut students, six weeks is simply not enough time for adipose tissue to shift detectably — especially without dietary changes.

Why Plyometrics Improves Heart Health

The drop in resting heart rate seen in both training groups can be theorised on the basis of the calculated observations given. During a plyometric session, the heart works hard by rising blood pressure and heart rate. But in the hours after training, the opposite occurs: a period of post-exercise hypotension (PEH), where both heart rate and blood pressure remain lower than baseline. Repeating this stimulus three times a week for six weeks, the cardiovascular system adapts structurally and functionally to handle the demand more efficiently.

For young women, this adaptation reflects a shift toward greater parasympathetic control (the nervous system's calming branch) which shows up as improved heart rate variability (HRV). HRV is increasingly used as a marker of cardiovascular health and stress resilience, and women tend to show higher HRV and faster heart rate recovery after exercise than men. This suggests the female autonomic nervous system may respond well to the kind of high-velocity, explosive stimulus that plyometrics provides.

There is also a mechanical efficiency angle. As the body gets better at using the stretch-shortening cycle, storing and releasing elastic energy more effectively, it needs less oxygen to perform the same movements. This improved economy reduces the metabolic demands of everyday activity, which in turn contributes to a lower resting heart rate. For previously inactive students, the early weeks of training typically bring rapid neurological and cardiovascular gains even before any visible changes in muscle size or body composition.

Why Body Fat Did Not Change: The Short-Term Paradox

Considering it as a “Normal Phenomenon”, the cardiovascular markers improve quickly, but body composition takes longer. The adjusted ANCOVA result suggests the training was nudging body composition in a positive direction. However, six weeks was not long enough for those changes to become statistically clear. Fat loss depends far more than exercise alone — hormonal balance, sleep quality, dietary habits, and total energy expenditure all play a role, and none of these were controlled for in this study.

Research across different populations supports this timeline. Short plyometric programmes of six to eight weeks consistently produce improvements in explosive power and jump height, but body fat changes tend to be small or statistically trivial. The main physiological shift during this early phase is in lean tissue — muscle quality and neuromuscular efficiency improve first. Studies in obese adolescents, where the energy deficit created by exercise is more substantial, show body fat reductions over 12-week programmes. For lean, healthy students like those in this study, the effect on fat mass is likely to emerge only with longer training durations or combined dietary strategies.

How These Findings Compare with the Broader Literature

The NIT Calicut results are consistent with a growing body of research on plyometric training in female athletes across team sports. Studies in soccer, volleyball, and basketball almost confirm that plyometrics reliably improves jumping ability, sprint speed, and change-of-direction performance in women. The cardiovascular gains seen here align with what has been reported elsewhere.

Soccer and Futsal

In female soccer and futsal players, six to eight weeks of plyometric training has been shown to improve high-intensity running capacity and shuttle run performance. A study by Silva et al. (2017) found that female futsal players did reduce body fat after a short-term programme, a result that contrasts with the present findings. The difference comes down to baseline fitness: competitive athletes typically have higher exercise intensities and greater overall energy expenditure per session than untrained students, making body fat changes more achievable in a shorter timeframe. Professional female soccer players also show stronger improvements in sprint speed and agility from plyometrics than from conventional strength training.

Volleyball and Basketball

For volleyball players, where jumping is central to performance, plyometrics is essentially non-negotiable. Research has also documented that high-intensity plyometric work influences key hormones involved in muscle growth and recovery, including growth hormone (GH) and insulin-like growth factor-1 (IGF-1). In basketball, seven-week plyometric programmes have improved lower-body strength and balance even when players were mid-season and dealing with accumulated fatigue, speaking of the robustness of the training stimulus.

Combining Plyometrics with HIIT

When plyometric exercises are embedded within a high-intensity interval training (HIIT) structure, the cardiovascular benefits become even more amplified. Studies comparing plyometric HIIT with cycling-based HIIT in active women found comparable improvements in VO2 peak and body composition. This is relevant because it confirms that plyometric exercise can carry a significant aerobic load when the work-to-rest ratios are structured appropriately, supporting the finding here that cardiovascular improvements are achievable even in a programme that was not primarily designed for aerobic conditioning.

Implications for University Physical Education

Universities are an underused resource for public health. They bring large numbers of young people together during a critical period of habit formation, and they have the infrastructure to deliver structured physical education at scale. Including plyometric training in college fitness programmes makes good sense: the exercises require no equipment, need only a modest amount of space, and deliver measurable cardiovascular benefits within weeks. For students entering sedentary professions in the already-fast-moving tech-integrated world, building this kind of physical resilience early is not a luxury but a practical investment.

Positing as a case of marginalisation, women are often under represented by sport science literature, and in many cultural contexts, they may face additional barriers to exercise. Yet the evidence for plyometric training in women is strong as it improves cardiovascular fitness, supports bone density — which matters for long-term prevention of osteoporosis — and does not require access to expensive facilities. A well-designed plyometric component in a women's physical education programme can address several health risks, providing a one-stop solution for most health crisis.

The broader public health case is reinforced by the accessibility of the method. Not every campus has a fully equipped gymnasium. Plyometrics can be done on a flat surface with nothing more than body weight. That makes it one of the few genuinely high-yield, low-barrier exercise options available to institutions with limited resources.

Conclusion

This study set out to test whether six weeks of plyometric training could meaningfully improve cardiovascular fitness and body composition in female college students and the answer is a qualified yes. Both training groups achieved significant reductions in resting heart rate, demonstrating that the heart becomes more efficient quite quickly in response to explosive, high-velocity exercise. Body fat did not change significantly in this timeframe, but the data suggest that the metabolic groundwork is being laid, and longer interventions would likely yield clearer compositional changes.

Perhaps the most practically useful finding is that intensity level did not determine whether participants benefited cardiovascularly. Both low and high-intensity plyometric protocols produced significant heart health improvements compared to the control group. This means that students and educators do not need to worry about hitting a specific intensity threshold as any structured plyometric programme appears to do the job.

Looking ahead, research should examine how female-specific hormonal factors, including menstrual cycle phase and hormonal fluctuations, interact with plyometric training adaptations. Studies extending beyond six weeks would also help clarify the timeline for body composition changes. In the meantime, the evidence here makes a clear and practical case: plyometrics is one of the simplest, most accessible, and most effective tools available for helping university students stay physically healthy in an otherwise sedentary academic world.

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