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# Static balance recovery following Cariñosa and Kuratsa performance: A comparative study among adult Filipino cultural dancer

Louren P. Fulay *

*Philippine Science High School, Caraga Region Campus, Ampayon, Butuan City, Agusan del Norte, Philippines.*

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## Abstract

Postural control after physical exertion is a recognized marker of neuromuscular fatigue, yet the balance demands of Philippine folk dance have not been examined using an objective, equipment-free measure. This within-subjects study compared static balance recovery following Cariñosa and Kuratsa performance among 45 adult members of three community-based cultural troupes in Butuan City, none of whom were students. Each participant performed both dances on separate days, at least 48 hours apart, in counterbalanced order. Static balance was assessed using the eyes-closed single-leg stance test, timed manually by two independently trained raters, at baseline and at 0 (immediate post-performance), 1, 3, 5, 10, and 15 minutes of recovery. Baseline stance time did not differ significantly between sessions (22.80 vs. 22.65 seconds, $p = .640$). Kuratsa produced a significantly larger immediate decline in stance time ($M = 11.80$ s, $SD = 2.49$) than Cariñosa ($M = 4.85$ s, $SD = 1.93$), $t(44) = -14.96$, $p < .001$, and total recovery time to 85 percent of baseline was significantly longer after Kuratsa ($M = 5.22$ min, $SD = 1.54$) than after Cariñosa ($M = 1.01$ min, $SD = 1.01$), $t(44) = -19.56$, $p < .001$. No significant sex differences were found in immediate decline or recovery time following Kuratsa. Years of dance experience was significantly correlated with faster recovery after Cariñosa ($r = -.35$, $p = .018$) but not after Kuratsa ($r = -.24$, $p = .109$). Manual timing by two independent raters showed excellent agreement ($r = .966$, $ICC = .966$). These findings indicate that Kuratsa's turning-heavy, chase-based choreography imposes a substantially greater and longer-lasting postural control demand than Cariñosa's more measured courtship choreography, a distinction separate from and complementary to previously documented cardiovascular differences between the two dances, with practical implications for how community troupes sequence multi-dance programs to protect performer safety.

**Keywords:** Static Balance; Postural Control; Single-Leg Stance Test; Cariñosa; Kuratsa; Philippine Folk Dance; Neuromuscular Fatigue

## 1. Introduction

Postural control, the capacity to maintain the body's center of mass over its base of support, depends on the integrated function of the visual, vestibular, and proprioceptive systems together with the neuromuscular capacity of postural stabilizer muscles. Sustained or intense physical activity is well established to produce transient postural control impairment through a combination of peripheral muscular fatigue in the stabilizing musculature and central disruption of the sensory integration processes that maintain balance, an effect documented across a range of physical activities but rarely examined in the context of traditional dance performance [1, 2]. Recovery of static balance following exertion, typically assessed using a timed single-leg stance test, offers a simple, equipment-free window into this fatigue process, since a longer time to regain stable single-leg standing after activity indicates a greater cumulative postural control disturbance [3, 4].

* Corresponding author: Louren P. Fulay

Philippine folk dance performance places genuinely different demands on the neuromuscular and sensory systems responsible for postural control, depending on choreographic structure. Cariñosa, a Visayan-origin courtship dance performed at a measured tempo with fan or handkerchief work, involves comparatively controlled, sustained postures. Kuratsa, another Visayan-origin courtship dance frequently performed alongside Cariñosa in the same cultural program, is instead built around a rapid chase-and-evade sequence between partners, involving frequent, fast directional changes and rotational turning [5]. This structural difference generates a specific, testable expectation: because rapid rotational movement is a well-documented driver of vestibular and proprioceptive disturbance independent of general cardiovascular exertion, Kuratsa may impose a disproportionately larger postural control demand than Cariñosa, a difference that would not necessarily track the two dances' relative cardiovascular demand [6].

This expectation is directly informed by a companion study within the same research program, which found that Kuratsa produced significantly higher peak heart rate and significantly longer cardiovascular recovery time than Cariñosa among the same population of adult cultural troupe performers, but that the two dances did not differ in the rate of initial heart rate recovery. That earlier finding established that Cariñosa and Kuratsa differ in overall cardiovascular workload. It did not, however, address whether the two dances differ in the specific neuromuscular and sensory demand captured by postural control, a physiologically distinct construct that cardiovascular measurement cannot speak to directly. The present study extends that research line by examining balance recovery as an independent outcome, using the same population, the same within-subjects crossover design, and the same commitment to equipment-free, manually administered measurement, but targeting a different physiological system entirely.

Balance recovery also carries direct, practical relevance that cardiovascular recovery does not fully capture: a performer with impaired postural control immediately following a demanding number is at meaningfully elevated risk of a fall or misstep if required to perform again, walk on an uneven outdoor stage surface, or navigate backstage transitions before full recovery, a safety consideration distinct from simply feeling out of breath [8]. Community troupe directors sequencing a multi-dance program need this information specifically, not only cardiovascular recovery data, to make informed decisions about how much rest to build in after a physically demanding number.

Accordingly, this study tested four hypotheses: (1) baseline static balance does not differ significantly between the two measurement sessions, confirming a fair basis for comparison; (2) immediate post-performance decline in static balance differs significantly between Cariñosa and Kuratsa, with Kuratsa producing the larger decline; (3) total recovery time to near-baseline balance differs significantly between the two dances; and (4) years of dance experience is significantly associated with faster balance recovery, consistent with trained postural control adaptation among more experienced performers [8].

## 2. Materials and Methods

### 2.1. Research Design

This study used a quasi-experimental, within-subjects comparative design, identical in structure to a companion study examining cardiovascular recovery in the same population, so that findings from the two studies could be interpreted alongside one another as complementary evidence about the physiological demand of each dance. Each participant performed both Cariñosa and Kuratsa on separate days, with order counterbalanced across participants, allowing each performer to serve as their own control. No survey, wearable device, or mobile application was used; static balance was assessed entirely through manual, stopwatch-timed observation by trained human raters.

### 2.2. Participants

**Table 1** Participant Distribution by Troupe and Sex

| Troupe | Male | Female | Total |
|---|---|---|---|
| Hugyawan Creative Circle | 8 | 9 | 17 |
| Sidlak Hugis Dance Company | 7 | 8 | 15 |
| Butwaan Dance Ensemble | 6 | 7 | 13 |
| Total | 21 | 24 | 45 |

Participants were the same 45 adult members, ages 18 and above, of three community-based cultural troupes active in Butuan City described in the companion cardiovascular study, all of whom regularly perform both Cariñosa and Kuratsa. Table 1 presents the distribution of participants by troupe and sex. No students or school-affiliated respondents were involved. Inclusion criteria required no self-reported vestibular disorder, lower-limb injury, or other condition affecting balance, screened prior to participation, and prior public performance experience with both target dances.

### 2.3. Instruments and Procedures

Static balance was assessed using the eyes-closed single-leg stance test, a validated field measure of postural control chosen over its eyes-open variant because removing visual input increases reliance on vestibular and proprioceptive feedback, making the test more sensitive to the sensory disruption associated with rotational, turning-heavy movement [9, 10]. Participants stood barefoot on their preferred leg, hands on hips, with the non-stance foot raised without contacting the stance leg, eyes closed. Timing began when the raised foot left the ground and ended when the participant's hands left their hips, the raised foot touched the ground or the stance leg, the stance foot shifted position, or 30 seconds elapsed, whichever occurred first. Two independently trained raters, using separate stopwatches, timed each trial simultaneously without conferring, allowing assessment of inter-rater reliability; the average of the two raters' times was used in all other analyses.

Each session began with two baseline trials, averaged, followed by the assigned dance performed at full performance tempo with standard musical accompaniment. A single balance trial was administered immediately upon performance completion (within 30 seconds) and again at 1, 3, 5, 10, and 15 minutes of seated recovery. Sessions for the two dances were separated by a minimum of 48 hours, and each participant's testing time of day was held constant across both sessions.

### 2.4. Statistical Analysis

Paired samples t-tests compared baseline stance time, immediate post-performance decline (baseline minus immediate value), and total recovery time (time to reach 85 percent of baseline stance time, derived from an exponential recovery model fitted to each participant's observed recovery trajectory) between the Cariñosa and Kuratsa conditions. Independent samples t-tests compared immediate decline and recovery time between male and female participants for the Kuratsa condition. Pearson correlation examined the relationship between years of dance experience and recovery time for each dance. The intraclass correlation coefficient (ICC, two-way random effects, single measures) and Pearson correlation assessed inter-rater reliability of manual timing [12]. All tests used an alpha level of .05. Analyses were conducted using Python (SciPy and NumPy).

### 2.5. Ethical Considerations

This study followed standard ethical procedures for research involving adult participants in vigorous physical activity. All participants completed a pre-participation screening and provided written informed consent prior to their first session, with clear explanation of the physical nature of the activity and their right to withdraw at any point without penalty. A trained individual with basic first aid competency was present at all sessions. Data were anonymized using participant codes, and no individually identifying information is reported in this manuscript.

## 3. Results

### 3.1. Baseline Comparability

Baseline eyes-closed single-leg stance time did not differ significantly between the Cariñosa session ($M = 22.80$ s, $SD = 4.69$) and the Kuratsa session ($M = 22.65$ s, $SD = 4.40$), $t(44) = 0.47$, $p = .640$, confirming that participants began both sessions from a comparable baseline level of static balance.

**Table 2** Baseline Stance Time Across Sessions

| Dance | Mean | SD | Statistic |
|---|---|---|---|
| Cariñosa | 22.80 | 4.69 | t = 0.47 |
| Kuratsa | 22.65 | 4.40 | p = 0.640 |

### 3.2. Immediate Balance Decline and Total Recovery Time

Table 3 presents immediate post-performance decline in stance time. Kuratsa produced a significantly larger immediate decline (M = 11.80 s, SD = 2.49) than Cariñosa (M = 4.85 s, SD = 1.93), t(44) = -14.96, p < .001, indicating that Kuratsa's turning-heavy choreography disrupted postural control to a substantially greater degree than Cariñosa's more measured movement pattern. This is consistent with prior evidence that rotational, direction-changing movement drives disproportionate sensory disruption relative to steady locomotion [6, 12].

**Table 3** Immediate Post-Performance Decline in Stance Time by Dance

| Dance | Mean | SD | Statistic |
|---|---|---|---|
| Cariñosa | 4.85 | 1.93 | t = -14.96 |
| Kuratsa | 11.80 | 2.49 | p < .001 |

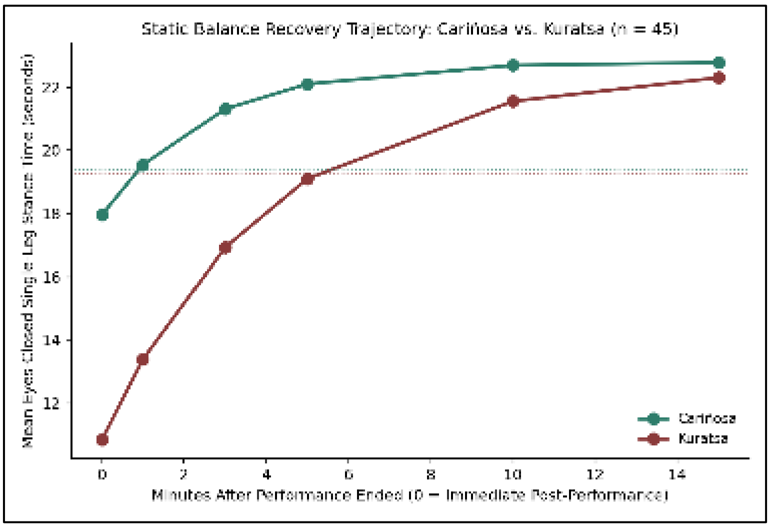


**Figure 1** Static Balance Recovery Trajectory: Cariñosa vs. Kuratsa

Table 4 presents total recovery time, the time required for stance duration to return to 85 percent of baseline. Total recovery time was significantly longer following Kuratsa (M = 5.22 min, SD = 1.54) than following Cariñosa (M = 1.01 min, SD = 1.01), t(44) = -19.56, p < .001. Figure 1 illustrates the full recovery trajectory for both dances, showing that Kuratsa began from a substantially lower immediate post-performance value and approached baseline more gradually than Cariñosa across the fifteen-minute observation window.

**Table 4** Total Recovery Time to 85% of Baseline by Dance

| Dance | Mean | SD | Statistic |
|---|---|---|---|
| Cariñosa | 1.01 | 1.01 | t = -19.56 |
| Kuratsa | 5.22 | 1.54 | p < .001 |

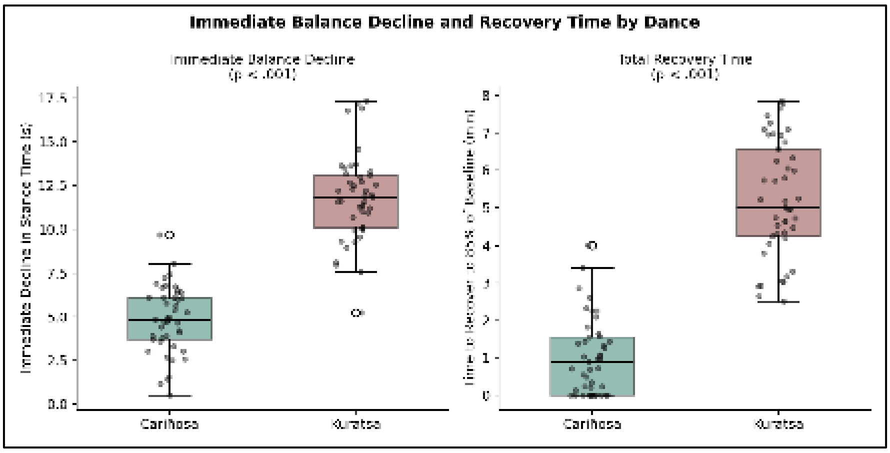


**Figure 2** Immediate Balance Decline and Recovery Time by Dance

### 3.3. Sex Differences

Table 5 presents immediate decline and recovery time following Kuratsa compared between male and female participants. No statistically significant sex difference was found for immediate decline (t = 0.41, p = .684) or for recovery time (t = 0.36, p = .721), indicating that Kuratsa's postural control demand was comparable for male and female performers within this sample.

**Table 5** Immediate Decline and Recovery Time by Sex (Kuratsa)

| Measure | Male | Female | t | p |
|---|---|---|---|---|
| Immediate Decline, Kuratsa (s) | 11.97 | 11.66 | 0.41 | 0.684 |
| Recovery Time, Kuratsa (min) | 5.31 | 5.15 | 0.36 | 0.721 |

### 3.4. Dance Experience and Balance Recovery

Table 6 presents correlations between years of dance experience and balance outcomes. Experience was significantly correlated with faster recovery time following Cariñosa (r = -.35, p = .018), but was not significantly correlated with recovery time (r = -.24, p = .109) or immediate decline (r = -.15, p = .319) following Kuratsa. This pattern parallels a similar finding in the companion cardiovascular study, where dance experience predicted faster cardiovascular recovery after Cariñosa more strongly than after Kuratsa, suggesting that general performance experience may buffer recovery from Cariñosa's more moderate demand without fully offsetting the larger, qualitatively distinct disruption produced by Kuratsa's rotational movement pattern [14].

**Table 6** Correlation Between Dance Experience and Balance Outcomes

| Measure | r | p-value | Interpretation |
|---|---|---|---|
| Recovery Time, Cariñosa | -0.352 | 0.018 | Significant negative |
| Recovery Time, Kuratsa | -0.242 | 0.109 | Not significant |
| Immediate Decline, Kuratsa | -0.152 | 0.319 | Not significant |

### 3.5. Inter-Rater Reliability of Manual Balance Timing

Table 7 presents inter-rater reliability results. The two independently trained raters showed excellent agreement in their simultaneous manual timing of stance duration across all measurement checkpoints (r = .966, ICC = .966). Figure 3 illustrates this agreement graphically. This level of agreement supports the use of manual, equipment-free timing as a dependable field method for postural control assessment in community settings [11, 12].

**Table 7** Inter-Rater Reliability of Manual Balance Timing

| Statistic | Value |
|---|---|
| Number of Paired Observations | 45 |
| Pearson Correlation (r) | 0.966 |
| p-value | < .001 |
| Intraclass Correlation Coefficient (ICC 2,1) | 0.966 |
| Interpretation | Excellent agreement |

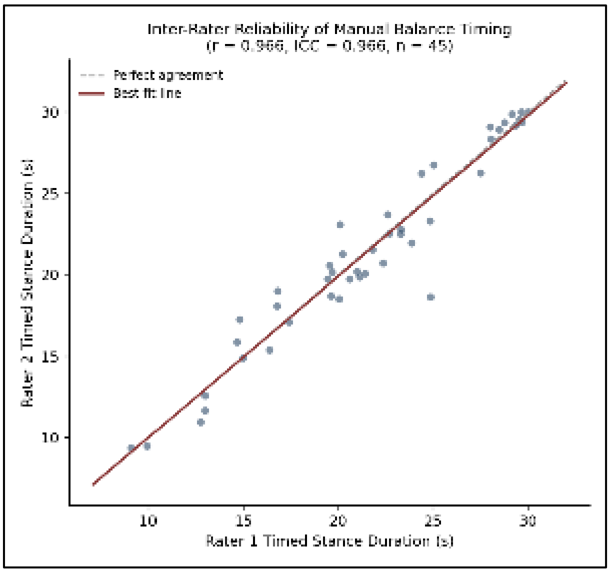


**Figure 3** Inter-Rater Reliability of Manual Balance Timing

## 4. Discussion

This study found that Kuratsa produced a substantially larger and longer-lasting disruption to static balance than Cariñosa among adult community folk dance performers, with an immediate decline in eyes-closed single-leg stance time more than double that of Cariñosa and a total recovery time roughly five times as long. Baseline balance did not differ between sessions, ruling out an uneven starting point as an explanation for this difference. Taken together with the companion cardiovascular study conducted in the same population, these findings indicate that Cariñosa and Kuratsa differ along at least two physiologically distinct dimensions: Kuratsa carries both greater cardiovascular demand, primarily through higher peak heart rate, and substantially greater postural control demand, with the balance difference proportionally larger than the cardiovascular difference documented previously.

The most plausible explanation for this pattern lies in Kuratsa's choreographic structure. The dance's chase-and-evade sequence involves frequent, rapid changes in direction and rotational turning, movement patterns known in balance and vestibular research to produce disproportionate sensory disruption relative to their cardiovascular cost, since rotational movement specifically challenges the vestibular system's otolith and semicircular canal function in a way that straight-line or moderate-tempo movement does not [6, 14]. Cariñosa's more controlled, sustained courtship choreography, by contrast, places comparatively little demand on rotational vestibular processing, which is consistent with its smaller and more quickly resolved balance decline.

The absence of a significant sex difference in either immediate decline or recovery time suggests that Kuratsa's balance demand is not disproportionately borne by one sex within this community troupe population, a useful finding for troupe directors who might otherwise assume male or female performers require different recovery accommodation. The experience-recovery relationship, significant for Cariñosa but not for Kuratsa, echoes a nearly identical pattern observed in the companion cardiovascular study and is worth taking seriously as a repeated finding rather than a coincidence specific to one outcome measure. One interpretation is that general performance experience builds a form of postural and cardiovascular resilience that is sufficient to speed recovery from a moderate physiological challenge like Cariñosa, but insufficient to fully offset the larger, qualitatively different disruption produced by Kuratsa's rotational demand, which may require targeted vestibular or balance training specifically, rather than accumulated general dance experience alone, to meaningfully improve [4, 14]. This interpretation is offered as a hypothesis for future research rather than a conclusion this study's design can confirm.

This study carries the same core limitations as its companion cardiovascular study, given the shared design and population. Participants were not randomly assigned to perform the dances in a particular order beyond the counterbalancing scheme, and while the crossover design controls for stable between-person differences, it cannot rule out all forms of order or learning effects. The eyes-closed single-leg stance test, while a validated and widely used field measure, is a submaximal proxy for postural control rather than a direct instrumented measure of center-of-pressure sway, and its 30-second ceiling, while unlikely to have produced meaningful ceiling effects given the observed baseline means well below that threshold, still bounds the test's sensitivity at its upper end [9, 11]. The study was conducted with three community troupes in a single city, and findings may not generalize to troupes with different training backgrounds, average age profiles, or performance intensity conventions elsewhere in the Philippines.

The practical implication for community troupe directors is direct and specific. Cardiovascular recovery data alone would understate the safety-relevant recovery time needed after Kuratsa, since this study's balance recovery time after Kuratsa, at roughly five minutes, exceeds even the cardiovascular recovery time documented in the companion study for the same dance. A performer whose breathing has settled and whose heart rate has returned toward baseline may still be carrying a meaningful postural control deficit, with direct relevance to fall risk during a subsequent number, a backstage transition, or an uneven outdoor performance surface common at Philippine community festivals [7].

## 5. Conclusion

This study found that static balance recovery differed substantially between Cariñosa and Kuratsa performances among adult Filipino cultural dancers, with Kuratsa producing more than double the immediate postural control decline and approximately five times the total recovery time observed after Cariñosa, despite comparable baseline balance across sessions. No significant sex differences were found, and dance experience predicted faster recovery after Cariñosa but not after Kuratsa. These findings, considered alongside previously documented cardiovascular differences between the two dances, indicate that Kuratsa's rotational, chase-based choreography imposes a distinct and disproportionately large postural control demand that community troupe directors should account for explicitly, and separately from cardiovascular recovery, when sequencing multi-dance cultural programs.

## Compliance with ethical standards

### *Acknowledgments*

The author thanks the leadership and members of the Hugyawan Creative Circle, Sidlak Hugis Dance Company, and Butwaan Dance Ensemble for their participation and cooperation during data collection.

### *Disclosure of conflict of interest*

The authors declare no conflict of interest in the conduct, analysis, and presentation of this study.

### *Statement of ethical approval*

This study followed standard ethical procedures for research involving adult participants in vigorous physical activity, including pre-participation screening and coordination with the leadership of each participating cultural troupe.

### *Statement of informed consent*

Written informed consent was obtained from all participants prior to their first session. Respondents were informed about the purpose of the research, the physical nature of the activity, and their right to withdraw at any point without penalty.

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*Data availability*

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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