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Continuous Pursuit of and Physical Injuries from Aesthetic Ballet Activities*

– How to Disconnect this Vicious Circle? –

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I. Introduction

Classical ballet as an artistic form is embodied by a codified technique that combines a series of movements, postures, and aesthetic elements (Hopper, Weidermann, & Karin, 2018). These ballet techniques have been continuously developed to achieve movement accuracy and artistry over the centuries. However, ballet techniques as aesthetic expressions require extreme physical abilities that exceed the capability of human body. According to an article featured in Popular Magazine in 2019, for performing Nutcracker, for example, a female dancer in the role of Clara must jump 196 times, which impose a big strain on bones and joints. A male dancer in another role must digest 6,000 newtons of force, eight times his weight.

Therefore, ballet dancers basically can be thought of as aesthetic artists, but they can create artistic excellence on stage only when their muscle strength, aerobic exercise ability, psychological stability, and excellent nutritional status are fully supported. If these physical and other abilities are not supported, professional ballet dancers may suffer from frequent injuries, and the injury incidence rate is reported as high as that of American football players (Popular Magazine, 2019).

This study was motivated from the perception of this situation in which ballet dancers' efforts to

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pursue artistic aesthetics can lead to excessive use of body parts, and eventually disrupt continuous artistic activities[1]. If ballet dancers are advised against repeated practice and movement involving overuse for the purpose of circumventing the problem, this may only make it impossible for them to master the ballet technique, making the sustainable pursuit of artistry difficult. However, if ballet dancers' overuse of body parts does not always lead to injury, but only when certain background conditions are met, then it becomes possible to make the overuse due to repetitive movements not necessarily lead to injury and disruption of continuous pursuit of artistry by preventing these background conditions.

This study was conducted to theoretically and empirically prove these hypotheses under the assumption that overuse of ballet dancers is a direct triggering cause for injury, but also, lower extremity alignment and control of physical balance are the indirect ground-preparing causes of injury, thus to derive implications for future conditions for preventing injuries and enabling sustainable pursuit of artistic aesthetics of ballet. Such scientific research can also be used as a basis for the development of efficient programs to strengthen the physical abilities of ballet dancers and prevent injuries in the future. As Twitchett (2009) and Popular Magazine (2019)[2] explain, developing physical training program based on scientific data has received little attention due to ballet researchers' narrow focus on the artistry of classical ballet and stereotypes of ballet dancers as artists.

To achieve this research purpose, this study collected and analyzed[3] data on injury experiences and causes by conducting a survey of 550 respondents including professional dancers working in ballet companies and students majoring in ballet at eight universities in Korea. Viewing the cause of ballet injury from a new perspective as done in this study is of academic significance in that it is a new attempt distinct from the conventional single-cause perspective viewing overuse as a sole causal factor. Most of the previous studies on ballet injury so far have limitations in that they have assumed and analyzed various causes, including overuse, as independently separate causal factors, but have not established a theoretical framework and hypotheses that reflects the interdependent causal structure among multiple factors. In addition, practical contributions can be also expected from this study. If

1) On many occasions ballet dancers become immersed in classes, rehearsals, and performances over a long period of time. Most of these ballet dancers' immersive efforts start from childhood and are constantly required to perform repetitive movements, and the use of these repetitive body parts leads to injury or chronic pain if the required movements are improperly performed. If ballet dancers suffer from injuries, they will not be able to participate in classes or performances, and as a result, they will not be able to sustain artistic development. For young ballet majors or aspiring professional dancers, injuries can be a real problem that leads to financial burdens or disruptions in time planning to achieve artistic or academic performance (Kenny, Whittaker, & Emery, 2016).

2) Popular Magazine (2019) explains that classical ballet dancers should be perceived as 'athletic artists' who require muscle strength, cardiopulmonary ability, psychological stability, and good nutritional status rather than just artists.

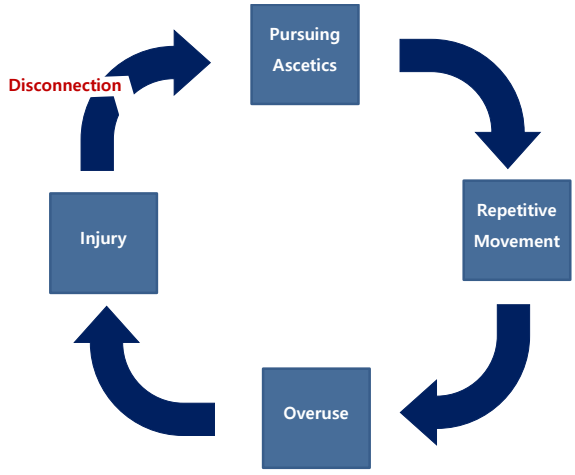
3) Frequency analysis, cross tablulation analysis, and probability analysis using Bayes Theorem were performed in this study.

the hypothesis of multiple causal structure is proven through the analysis of this study, it will become possible to disconnect the vicious cycle of repeated practice and/or performance leading to injury incidence by developing a physical training program based on the principle of controlling ground-preparing causes.

II. Theoretical Frameworks and Research Methods

1. Theoretical Framework

As can be seen in <Figure 1>, the pursuit of aesthetics in ballet requires artistic expression through extreme body movements beyond the anatomical limits of the human body, so repeated practice to master and embody the techniques must be followed. The basic problem recognition of this study is that repetitive performance or practice of ballet movements inevitably causes excessive overuse of body parts, which leads to the serious injury of ballet dancers, making it no longer possible to continue ballet art activities. In other words, the continuous pursuit of ballet artistry rather creates a vicious cyclic relationship that makes it difficult to continue ballet artistry (as expressed "disconnection" in the <Figure 1>).



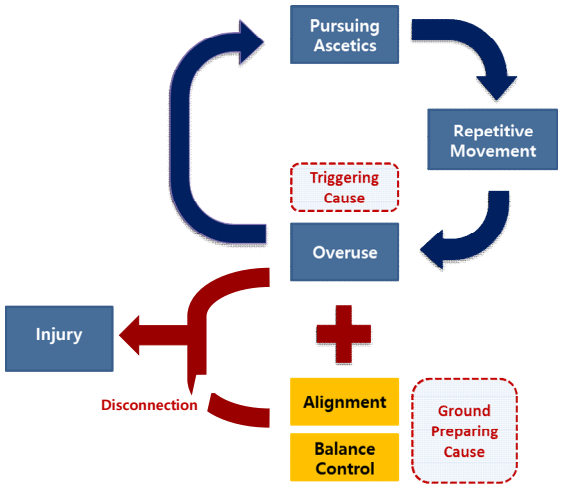
<Figure 1> Aesthetics Pursuit Cycle Disrupted by Injury

To develop a solution for the problem under this contradictory relationship, it is necessary to understand the causal relationship between ballet dancers' repeated use of body parts and resulting injuries in a framework of multiple causal relationship, not a single-cause causal relationship.

According to Befani (2012), counterfactual approach, the main methodology of causal inference in social and natural sciences, makes it possible to infer only single-cause causal relationships, while scientists are frequently required to infer causal relationships with multiple causal factors. In the multi-cause causal relationship framework, causal factors are classified into '*direct triggering causes*' and '*indirect ground-preparing causes*.' It is true that the triggering factor is the direct cause of a result, but the result does not occur with only one triggering factor, but only when the ground-preparing factor is combined. In other words, either of triggering factor or ground-preparing factor is a necessary condition for the occurrence of a result, but not a sufficient condition by itself.

Instead, under this causal structure, they become sufficient conditions only when the two types of causes are combined.

This causal structure can also be applied to the problem of this study. As can be seen in <Figure 2>, overuse does not always lead to injury, but only when a problem occurs in a dancer's body alignment or balance control ability. Hence if overuse is said to be the triggering cause, the problem in body alignment or balance control ability can be regarded as the ground-preparing causes. If it is possible to block the intervention of ground-preparing causes by ensuring the integrity of body alignment or balance control, the causal link that overuse leads to injury can be disconnected (as shown in Figure 2), and as a result, a virtuous cycle of sustainable pursuit of artistry or aesthetics can be created.



<Figure 2> Virtuous Aesthetics Pursuit Cycle under Multiple Causation Framework

In the above theoretical framework, the three research questions this study seeks to explore arise as follows: firstly, "Does repetitive performance of ballet movements lead to overuse and injury?" (direct triggering cause), secondly, "Is lower extremity alignment the ground-preparing cause of injury due to overuse?," and lastly "Is balance control (or core stability) the ground-preparing cause of injury due to overuse?" If these hypotheses are proven to be true, training to improve lower extremity alignment and balance control will cut off the causal link that leads to overuse to injury and allow ballet dancers to continue to perform art activities.

2. Previous Research

I will examine the results of previous studies that support the theoretical framework of this study presented above. There are three main types of previous studies to consider: first, studies on the hypothesis that the pursuit of aesthetics in ballet art causes overuse of body parts and ultimately leads to injury; second, studies on the hypothesis that lower extremity alignment acts as the ground-preparing cause of injury, and third, studies related to the hypothesis that balance control acts as the ground-preparing cause of injury.

1) Overuse and Injury: Direct Triggering Cause of Injury

According to a study by Shan (2005), the problem of injury in the dance world is increasingly

important as a problem that intensifies not only the problem of not being able to pursue artistry but also that of financial stability. According to Garrick and Requa (1993; re-quoted in Shan, 2005), the medical cost of a ballet dancer's injury amounts to $1,289 per occurrence. The main cause of this injury is claimed to overuse, and according to Shan, 64% to 80% of professional dancers experience interruption of performance activities for a considerable time period due to Overuse Syndrome (OS).

According to a study by Bruyneel et al. (2010), 80% of ballet dancers face pathological injuries every year they are active. According to Luke et al. (2002: Kenny, Whittaker & Emery, 2016), ballet majors before becoming professional dancers were exposed to 4.7 hours of injuries per 1,000 hours, comparing with 4.5 hours per 1,000 hours for youth indoor soccer players, 2.6 hours per 1,000 hours for elite adult gymnastics, and 1.4 hours per 1,000 hours for ice skaters.

The reason why ballet dancers are exposed to this high risk of injury is that the artistic movements required in ballet often include movements such as turnouts and points beyond anatomical limits of human body. According to research by Kenny, Whittaker and Emery (2016) or Watkins et al. (1989), ballet is recognized as an activity that requires a higher physical burden than any other sports. The rigorous training process for honing dance styles that require high levels of physical and artistic skill exposes dancers to the risk of musculoskeletal injuries (Kenny, Whittaker & Emery, 2016). Many studies have shown that the most frequent musculoskeletal injuries in ballet dancers are caused by overuse and lower extremity injuries (Kenny, Whittaker & Emery, 2016, p. 997).

Another example of the ballet technique movements adds to the risk of physical injury is that the 'lateral bias' that ballet techniques can create may act as a factor to disrupt pelvic alignment and eventually lead to a risk of injury. According to a study by Mertz and Docherty (2012), the legs of ballet dancers and most healthy athletes cannot be said to be symmetrical in terms of frequency of use, functional competence, and muscle characteristics. However, ballet essentially requires dancers to use both legs equally, and at least in theory, ballet classes require that both legs be trained in balance and the same exercises and movements be performed on each leg. However, since ballet performances require more frequent repetition of right leg movements or more frequent expression of right leg at the beginning of barre and center combination, physical and functional asymmetry of the dancers' lower extremity may exist, which can be defined as the concept of *lateral bias*. Mertz and Docherty explains that the presence of lateral deflection can cause excessive development in one leg, leading to lower extremity injuries or chronic pain in dancers.

2) Lower Extremity Misalignment and Injury: Indirect Ground-Preparing Cause #1

According to many studies, the most frequent musculoskeletal injury in ballet dancers is lower extremity or lower back injury due to overuse (Kenny, Whittaker & Emery, 2016, p. 997). Kadel (2006)'s study of foot and ankle injuries of dancers reveals that 17% to 24% of modern dancers are

experiencing injuries, while 67% to 95% of ballet dancers are experiencing injuries, which is a high percentage. Watson et al. (2017) reported that 82% of professional modern dancers in the United States have experienced injuries within the past 12 months, while this rate for professional ballet dancers reaches 95%. According to Viktoria et al. (2016) and Kline et al. (2013), the rate of back injury experiences among American ballet dancers is rapidly increasing from 8% in the past to 23% in recent years. The cause of injury to the lower extremities due to excessive use is due to the 'incomplete body alignment of the lower extremities or pelvis.' A study by Kenny, Whittaker, and Emery (2016) reports that 'the tilt of sacrum at a turnout at an angle of more than 30 degrees' is the main cause of musculoskeletal injury.

Decert, Barry and Welsh (2007), who conducted an experimental study on pelvic alignment of college ballet majors, emphasizes that classical ballet training should be aimed at pursuing harmony of artistic and physical skills through perfect alignment of the human skeleton. It is explained that efficient pelvic alignment enables efficient motion, enables efficient utilization of hip joints and lumbar vertebrae, and is ultimately a key factor in determining the success of a dancer's career. It is explained that if the pelvic alignment is broken, compensatory movements and excessive muscle tension may cause stress, knee, foot, and ankle injuries in the spinal area.

Like Kenny, Whittaker, and Emery (2016), another study identifying lower extremity alignment as the main cause of injury is the study by Watkins et al. (1989). This study measured the knee-foot alignment angle of 22 young (under 13) dance majors, 171 aspiring professional dancers, 58 dance majors, and 99 professional dancers and studied their relationship to injuries. Their study found that young dancers had the greatest angle of departure from the center axis compared to other groups, so they tended to force the turn-out posture from their ankles and consequently increased the risk of injury by applying inappropriate stress to their knees.

Like the above studies, a study by Bowerman et al. (2015) identifies lower extremity alignment as a risk factor for injuries to young elite female ballet dancers. Their study examines the risk factors of low extreme overuse injuries in adult ballet dancers through meta-analysis of 13 previous studies and concluded that incorrect lower extremity misalignment was one of the main risk factors causing ankle and foot injuries.

Many previous studies have mainly described the mechanism by which the incompleteness of lower extremity alignment leads to injury as "*inappropriate compensation behavior*." Watkins et al. (1989)'s study relates the concept of lower extremity alignment to an essential turn-out motion in a successful ballet dancer's career, explaining that if the lower extremity alignment is properly achieved, the turn-out occurs at the hip and the knees are aligned close to the center of the foot. However, if the range of the external movement of the hip socket is limited, the ballet dancer performs a compensatory movement that incorrectly turns out of the knee or ankle, not the hip joint, and this

excessive compensation movement allows the knee to be aligned far ahead of the medial border of the foot. Watkins et al.'s study explains that this incorrect turn-out behavior causes twisting of the musculoskeletal structure, causing chronic injuries to the lower extremities such as knees, ankles, and feet. A study by Deckert, Barry and Welsh (2007) also states that when the pelvic alignment is disturbed, compensation movements and muscle tension can occur, which can cause lumbar, knee, foot, and ankle injuries. Bowerman et al. (2015)[4]'s study also points out that abnormal alignment of hips, knees, and ankles is a major risk factor for lower extremity injuries.

3) Balance Control Ability and Injury: Indirect Ground-Preparing Cause #2

Along with the lower extremity alignment, the main ground-preparing factor for injuries caused by overuse in this study is balance control or core stability that enables it. A study by Lin et al. (2011) comparing postural stability in 33 ballet dancers explains that ballet dancers require a high level of balance control to perform the extreme range of movements required by ballet (e.g., extensive ankle flexion, extreme hip extension). Flexibility alone is not enough to perform an extreme range of joint movements, and balance control is required, and if this is not done properly, ballet dancers are exposed to the risk of injury.

According to Kline et al. (2013), common causes of injuries to ballet dancers include overuse, long practice time, floor, inappropriate shoes, fatigue, and poor health, and spondylosis. Injuries such as degenerative disc disease, muscle injuries, fractures, and discogenic pain are said to occur. Their research points out that the muscles around the spine are not properly controlled and the lack of core stability are the two main causes of waist injuries.

Ambgaonkar et al. (2012) explains that core stability is a major cause of the prevention of injuries to ballet dancers, and that if any of the three components that make up core stability are deficient, the balance of the lumbar pelvis will collapse before the total movement of the periphery begins. This explains that instability in the lumbar pelvis causes compensatory adjustment of the torso and lower extremity, which in turn leads to inefficient physical force and injury.

According to a study by Bruyneel et al. (2010), if the balance of the posture is broken during ballet, the 'rebalance strategy' that can be used to rebalance can appear as an ankle-centered or hip-centered, and if the balance is seriously broken, it can lead to an extreme counter-movement of arms, such as parachute reaction, to avoid falls, and ultimately to a serious injury.

4) According to Bowerman et al. (2015), if a dancer's range of movements is limited, it is explained that the dancer's kinetic chain operates the compensation strategy to perform the turn-out movement. It is explained that if this compensation action occurs at an anatomical point, not at a hip joint, in other words, if lumbar lordosis, pronation of the foot, and ablation of the forefoot occur, dancers are exposed to a very large risk of injury.

3. Methods: Survey Research

It was confirmed that the theoretical framework of this study presented above has already been supported by many previous studies as discussed. In addition, in this study, a structured survey was conducted to find answers to the three research questions by empirically verifying the major causal relationships constituting the theoretical framework. The survey was conducted on 550 professional ballet dancers and ballet majors working and studying in Korea. The questionnaire used in the survey was prepared in a form like a questionnaire used for epidemiological investigation of injuries experienced by ballet dancers in the study of Balding (2004). As Balding (2004, pp. 57-58) stated, the questions contained in this questionnaire were originally used in other studies in the past for epidemiological investigations of injuries related to other sports, which were adapted to epidemiological investigations of injuries of ballet dancers. Balding reveals that a separate focus group discussion was conducted prior to implementing this questionnaire to further verify the validity of the questionnaire.

For this study, survey questionnaires were distributed by visiting-survey method to a total of 550 dancers working at five ballet companies in Korea and ballet majors attending eight university dance departments, and the answers were collected from 528 repondents. In the analysis conducted in this study, most of the analysis was conducted with 525 effective samples that provided valid responses to the key variable of this paper, ‘whether or not to experience injury’.

The main characteristics of the sample constructed through the survey are as follows. The 406 people, or 76.9% of the total sample, are female dancers, and the remaining 23.1% or 122 are male dancers. The 340 respondents, or 66.7% of the sample, college ballet majors, and the remaining 35.3% or 185 are professional ballet dancers. The average age of the female sample is 22.6 years old, and the average of the male sample is 25 years old. The total ballet career is 11.7 years for women and 10.1 years for men. The professional ballet career is 4.7 years for women and 5.5 years for men. The 35.2% of the total samples were professional dancers belonging to professional ballet companies, and the remaining 64.8% were college students.

III. Analysis Results

1. Overuse and Injury: Direct Triggering Cause of Injury

First of all, looking at the analysis result of the overall injury status of ballet dancers included in the survey sample, 87% of the 525 effective samples who responded to the presence or absence of injury experienced ballet-related injuries more than once so far. The previous study of Bruyneel et al. (2010)

is almost similar to the result of this study that 80% of ballet dancers experience pathological injuries every year they are active.

Next, to find the answer to the first research question of this study, "Is the pursuit of excessive ballet art activities related to the risk of physical injury?", I analyzed the relationship between whether or not being a professional ballet dancer, length of ballet career, and length of practice time and the risk of experiencing ballet injury.

The results of analyzing the injury status by dividing subgroups depending on whether they are professional dancers belonging to professional ballet companies or college students majoring in ballet at university can be taken as evidence to suggest how overuse is related to the risk of injury. A study by Rein et al. (2011) illustrates that professional dancers generally have a much better posture control and sense of posture, even though they are required to perform a much wider range of movements than amateur dancers but may be exposed to higher risk of injury due to overuse[5].

The analysis of this study also shows corresponding results to that of Rein et al. (2011). As shown in the table, 84% of college students majoring in ballet were found to have experienced injuries, while 92% of professional dancers belonging to professional organizations said they had experienced injuries. These results are consistent with the findings from Kenny, Whittaker, and Emery's (2016, p. 997) study arguing that overuse was the main cause of injury, and that from Kadel's (2006) study explaining that long performance times or severe rehearsal schedules were the main causes. Watson et al. (2017) also stated that 95% of professional ballet dancers in the United States have experienced injuries within the past 12 months, which is almost consistent with the results presented in the table below.

The hypothesis that repetition of ballet art activities may cause excessive use of certain body parts and ultimately lead to physical injury can be tested by examining the relationship between the injury experience and the length of ballet career or the length of average practice time per day. As shown in the table, 85% of respondents with less than 10 years of total ballet experience experienced injuries, while 91% of respondents with more than 10 years of ballet experience experienced injuries, showing a statistically significant difference. In the same vein, 84% of respondents with less than 5 hours of practice per day said they experienced injuries, while 91% of the other sample group said they experienced injuries, providing clues to the relationship between repetitive performance of excessive ballet art movements and injuries.

5) Likewise, a study by Sobrino et al. (2015) explains that the most important cause of injury for professional ballet dancers is overuse, and in particular, classical ballet dancers who require the most technically difficult movement are exposed to a higher risk of injury.

<Table 1> Cross Tabulation Analysis for Relationship between Overuse and Injury

	Injury	No injury	Total
College Ballet Majors	287	53	340
	84%	16%	100%
Professional Ballet Dancers	170	15	185
	92%	8%	100%
Total	457	68	525
Career <= 10 years	237	43	280
	85%	15%	100%
Career > 10 years	213	22	235
	91%	9%	100%
Total	450	65	515
Practice < 5 hours/day	223	43	266
	84%	16%	100%
Practice > = 5 hours/day	229	24	253
	91%	9%	100%
Total	452	67	519

2. Lower Extremity Alignment and Injury: Ground-Preparing Cause of Injury #1

The second research question to be answered in this study is 'Is the lower extremity alignment the ground-preparing cause of the injury?' and 'How serious is the injury that caused by the problem in the lower extremity alignment?' Looking at the results of the previous studies discussed earlier, the common conclusion of many studies is that the most serious injuries commonly experienced by ballet dancers are mainly injuries that occur in the lower extremities and waist areas. The table below shows how often the survey respondents experienced injuries to their lower back or lower extremities, and 86% of the respondents said they had experienced injuries to their lower extremities or lower waist, which is almost the same as the overall injury rate analyzed above[6].

<Table 2> Frequency of Experiencing Injury in Lower Extremity or Lower Back

	Frequency	Percentage
Experienced injury	452	86%
Not experienced injury	73	14%

If so, what is the proportion of the lower extremity and waist injuries in total injuries? To obtain an answer to this question, the results of cross-tabulation between the frequency of the overall injury and

6) Comparing these rates with the frequency of injuries in the upper body, only 51% of respondents said they had experienced injuries in the upper body part. This is significantly different from the percentage (99%) who said they had been injured in the lower extremities and waist areas.

the lower extremity and back injury are shown below. As shown in the table below, 99% of respondents who have experienced injuries at least once in any part of the body said they had experienced injuries to their lower extremities and waist areas. In fact, almost all respondents who experienced injuries experienced lower extremity and waist injuries, suggesting that one of the main causes of injuries caused by overuse stems from problems with lower extremity alignment.

<Table 3> Cross Tabulation Analysis between Overall Injury and Frequency of Lower Extremity and Lower Back Injury

	Lower extremity or lower back injury		Total
	No	Yes	
Injury experience	5	452	457
	(1%)	(99%)	(100%)
No injury experience	68	0	68
	(100%)	(0%)	(100%)
Total	73	452	525

If so, is the injury to the lower extremities and waist experienced by ballet dancers serious enough to prevent them from continuing ballet art activities? To find an answer to this, the frequency of temporarily suspending ballet due to injuries to the lower extremities or waist was analyzed and presented below. As can be seen below, 57% of all respondents said they had experienced stopping ballet due to injuries to their lower extremities or waist.

<Table 4> Severity of Lower Extremity and Back Injury: Whether Temporarily Stopped Ballet

	Frequency	Percentage
Not stopping ballet	226	43%
Stopping ballet	299	57%

If one wants to answer the question, “What is the probability that a ballet dancer will stop ballet if he is injured in the lower extremities and waist areas?” one can use the Bayes’ theorem as shown below to obtain the solution.

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B)}$$

The theorem of probability theory, which can be expressed as the above equation, is the Bayes theorem, and when applied to the solution of the problem presented above, it can be expressed as the following equation.

$$\Pr(Stop\ Ballet|\ Lower\ Extemity\ Injury) = \frac{\Pr(Lower\ Extemity\ Injury|Stop\ Ballet) * \Pr\ (Stop\ Ballet)}{\Pr\ (Lower\ Extemity\ Injury)}$$

According to the above frequency analysis results, Pr (*Lower Extemity Injury*) = 0.8610, Pr (*Lower Extemity Injury* | *Stop Ballet*) = 0.9934, and Pr (*Stop Ballet*) = 0.5733.

$$\text{Hence, Pr } (Stop\ Ballet\ |\ Lower\ Extemity\ Injury) = \frac{0.9934 \times 0.5733}{0.861} = 66.1\%$$

In other words, if a ballet dancer is injured in the lower extremities and waist areas, the dancer may suffer from an injury as serious as suspending the ballet activities with a 66.1% of probability.

3. Balance Control and Injury: Ground-Preparing Cause of Injury #2

The third research question of this study is the question of 'Is balance control or core stability the indirect ground-preparing cause of injury?' To find the answer to this problem, we conducted a frequency analysis of the results of 428 responses to the question, "Do you think your body is balanced left and right when you focus on the spine and pelvis?" As shown in the results below, 79% of respondents who said they were in physical balance experienced injuries, while 90% of respondents who were not in physical balance experienced injuries, indicating that physical imbalance was an important ground-preparing cause of injury.

<Table 5> Injury Experience Depending on Whether Achieving Physical Balance

	Injury Experience	No Injury	Total
No Physical Balance	313	33	346
	(90%)	(10%)	(100%)
Physical Balance	65	17	82
	(79%)	(21%)	(100%)
Total	378	50	428

A similar analysis was performed for injuries to the lower extremities and waist areas. As the results show, 90% of respondents who said they did not achieve physical balance had experienced lower extremity and waist injuries, while only 78% of respondents who said otherwise had experience injuries, suggesting that the analyses results from this study are consistent with those of studies by Watkins et al. (1989), Deckert, Barry and Welsh (2007).

<Table 6> Cross Tabulation Analysis between Overall Injury and Frequency of Achieving Physical Balance

	Lower extremity injury		Total
	Yes	No	
No Physical Balance	312	34	346
	(90%)	(10%)	(100%)
Physical Balance	64	18	82
	(78%)	(22%)	(100%)
Total	378	50	428

IV. Conclusion

The dancer's movements expressing the aesthetic artistry of classical ballet can only be expressed on the stage by completely embodying the movements through repeated practice. However, as highlighted in studies by Kenny, Whittaker, and Emery (2016) and Watkins et al. (1989), overuse of body parts resulting from repetitive movements acts as one of the most important causes of injury risk experienced by ballet dancers. This fact was reverified by analyzing the data of survey responses and confirming that professional dancers with high tendency to overuse body parts, dancers with long ballet experience, and dancers with longer average practice time experienced actual injuries than the comparison group.

A way to suppress overuse cannot be a feasible alternative for ballet dancers to pursue continuous artistry without being exposed to the risk of injury. The reason is that overuse is a necessary condition not only for injury, but it is a necessary condition also for pursuing artistry. To solve this contradictory problem, this study viewed this problem and conducted an empirical analysis in the multiple-causation framework; in which overuse alone does not cause injury, but only in combination with major ground-preparing causes such as misalignment of lower extremity or lack of balance control. As a result of empirical analyses, it was confirmed that lower extremity misalignment or lack of balance control were key ground-preparing causes that lead to injuries as serious as to even disrupt continuous pursuit of artistic activities.

The remaining task in the future is to develop and introduce a physical strength training program for classical ballet dancers that suppress these ground-preparing causes based on biomechanical research. As Twitchett (2009) explains, most of the training methods currently used in classical ballet classes focus on increasing movement vocabulary, improving skills, and developing musicality, while programs to train necessary muscle strength and balance control ability based on scientific data are insufficient. The results of this study can be used as a logical basis for justifying the needs for developing such programs.

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Abstract

Continuous Pursuit of and Physical Injuries from Aesthetic Ballet Activities

– How to Disconnect this Vicious Circle? –

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Ballet techniques as aesthetic expressions require extreme physical abilities beyond the anatomical limit of human body. This study was motivated from perceiving the situation in which ballet dancers' efforts to pursue artistic aesthetics lead to overuse of body parts and eventually disrupt continuous artistic activities. To solve this contradictory problem, this study viewed this problem and conducted an empirical analysis in the multiple-causation framework; in which overuse does not cause injury alone, but only in combination with major ground-preparing causes, such as body misalignment or balance control. As a result of empirical analyses, it was confirmed that lower extremity misalignment or lack of balance control actually act as key ground-preparing causes that lead to injuries serious enough to disrupt continuous pursuit of artistic activities. As a next step, my findings suggest that it is desired to develop a strength training program that effectively suppresses those ground-preparing causes.

Keywords: Injury(부상), Overuse(과다사용), Lower extremity alignment(하지 정렬), Balance control(균형제어), Ground-preparing cause(배경적 원인)