

## **Chapter 11 : Anatomy for Skateboarding**

### **Introduction**

This chapter details a short literature review, the participant's historical bodily composition, and overuse injury remediation practices while learning skateboarding tricks. The purpose includes recording challenges faced conveyed through text summaries, image sets for technique review, and charts to visualize muscular issues and is written at an undergraduate level for the layperson. The author is a research scientist but does not have a degree in medicine or sports science and most of the information included is knowledge acquired from decades of athletics. The most challenging aspect of learning skateboarding was overuse because of the smaller muscles used and because beginner skateboarders look foolish for several months. Anti-skateboarding sentiment is amplified by automated negative internet content generation that was developed by private security systems and overly competitive athletes at the turn of the millennium whose methods are covered in previous chapters. Extreme sports became a popular alternative to traditional exercises like weight lifting or football and the legality was illicit or unaddressed by law enforcement. If they existed locally, skateparks were overly crowded beginner hating injury traps and spawned a skateboarding web development maze. The final chapter covers a more in-depth examination of anatomy through an extended dataset and graduate academic research.

### **Background**

What strikes this amateur of anatomy and kinesiology most is the increased risk for bodily injury while starting a new sport like skateboarding. The most obvious injuries are random bone breaks from progressing difficulty of tricks too rapidly but it was more of a curiosity to see if the fundamental motions of skateboarding would lead to long term bodily impairment. One search revealed information on the Newton forces generated from falls of various heights conducted by researchers at Ohio University. Their study examined gymnastic participants and a non gymnastic control group to compare force applied on the legs for drop landings from various heights. They found that gymnasts experience more muscular impact because they land with stiff or minimal flexion of the lower extremity joints to acquire more points within the sport as compared with non-gymnasts performing the same study's measurements. The article implies that muscle memory of gymnasts land in a more rigid condition and would have greater risk for lower body injuries but the paper's inclusion in this review is to summarize the physics force of landing (16). Immediate damage to cartilage because of physiological activities was studied in vivo using magnetic resonance imaging to measure deformation as performed by Austrian and German researchers. The study supports evidence that cartilage regains voluminous form within 90 minutes of physical activity and that reduced loads because of immobilization from activities such as surgery are associated with cartilage atrophy. Excessive exercise is not associated with thicker cartilage mass (6).

Another relevant concern for more permanent bodily injury from skateboarding is the assessment of various environmental effects on body compositions as it impacts joint inflammation. The two primary sources of joint swelling are osteoarthritis which is the breakdown of cartilage from decades of usage commonly found in the elderly or rheumatoid arthritis where the immune system attacks its own cartilage. Both of these primary forms of

arthritis are related to genetics and environmental factors. One Chinese study that examined 12,000 people over 16 years found an association of tap water drinkers with more healthy cartilage than well, surface, or spring sources which implies that ease of access and employees dedicated to sanitation would increase clean water consumption by the healthy cohort (26). The information coding of well water seems ambiguous as a well water station might draw water from mechanical pumping lowering the difficulty of acquisition but might still contain pathogens that increase the likelihood of rheumatoid arthritis.

Building from this information is a study conducted by the United Kingdom Universities of Birmingham and Aberdeen that examined the water content of in vitro bovine cartilage concluding that more hydrated bones had less stiff cartilage and would probably have less joint related issues (5). Hellenic Mediterranean University and University of West Attica researchers found that many endurance athletes lack salt from overhydration and low sodium diets commonly known as hyponatremia (25). It is applicable to skateboarding because low body weight skaters might eat low sodium diets while lacking the ability to stay properly hydrated, leading to prematurely damaged cartilage. Body composition in adolescent sports participants were examined and found that obese children suffered fewer injuries (7). One possible explanation is that excess fat provides cushioning between blows in uncoordinated and rapidly growing limbs in children experiencing puberty. Someone new to skateboarding would have similar awkward falls for several months from a lack of coordination maneuvering the board and it would follow that additional padding would reduce the chances of significant injury. Long term effects would include bad eating habits leading to adulthood obesity and health complications like diabetes, hypertension, and increased risk for heart attack, stroke, and early death. Guidance to fluid replacement is summarized by the American College of Sports

Medicine (16) wherein specific pre-hydration rates before exercise were developed for the variable sweating loss of the participant. The goal for hydration during longer activities is to prevent greater than 2% body weight loss from water expenditure.

Additional injury prevention strategies include improvements to muscular tissue through increasing muscle mass which appears to lead to less bodily injuries in a study by University of California Davis. They examined loss of muscle strength as it relates to increased injury rate in the elderly with the general idea being that thicker muscles absorb and pass more Newton force than atrophied muscles (8). Although skateboarding is a primarily lower body sport, muscle coordination and development of the upper body muscles is deemed necessary for balance by kinesiology researchers in Germany and Slovenia who measured a group of participant's balance with hands on thighs, outstretched, and flailing about. The outstretched and flailing arms contributed more to balance than hands on thighs (4).

Researchers also looked at the accumulation of muscular fibrosis in animals subjected to performing repetitive usage and attempts to minimize the scarring through stretching and resting versus resting alone. Injury risk seems to increase without breaks from repetitive use. They found that small amounts of physical stretching and avoiding the activity that tore the muscles could reduce fibrosis when compared with resting alone (3). A comprehensive review of the physiological processes involved in skeletal muscle tissue fibrosis and the efforts to reduce existing damage is available in the National Library of Medicine government website as conducted by researchers at Duke University. Several of these are not approved for usage outside of trials because of the probability for misuse (18). The only muscle that cannot regenerate itself is the heart and there is significant potential for abusing STEM cells in a quest for immortality.

Scientists at the University of Cincinnati and Western Michigan examined similar novel approaches (9).

Other studies reviewed for this paper include a small sample of high arch footed sprinters being faster than low arch sprinters (20). There are several theories hypothesized by this writer as to the cause of this observation such as an increased tolerance for pain from intense exercise measured by the vector of narrower shoes morphing feet. Since the study is not a longitudinal examination of the sprinter's foot morphology before, during, and after the inclusion of intense track and field exercise, it is difficult to draw meaningful conclusions from the paper. Soft narcotic use in the form of cannabis is perceived to occur in the sport of skateboarding and a paper from the 1970's was reviewed that studied THC as a histamine antagonist in animal cells (22). It implies that cannabis works to reduce inflammation. This was surprising since it was assumed that consuming the flower portion of the cannabis plant containing concentrated amounts of THC would elicit a histamine response in the form of an allergic reaction. Histamine in general increases fluid to the areas where the allergen is detected to deliver required nutrients to dispel the foreign substance and could possibly increase bodily padding from fluid retention. It is also possible that couch lock or consuming weed and not moving for several hours while alleviating dry mouth from smoking and increasing the study's hydration levels are the cause of the antihistamine properties.

Since most human habitation is located on bodies of water and since this study is located inland, it stands to reason that the local environment is in a river valley or near a lake. Access to water serves bird and insect pollinators as a migratory corridor and produces large amounts of pollen in the spring and early summer which are similar to less intense effects of legal cannabis. The effect is similar to indoor skateboarders who might be trained during exposure to dandruff or

mold. State dependent learning (SDL) has been well documented since the 1960's with experiments by psychiatrists to retrieve traumatic stress, cure drug addiction, or induce schizophrenic episodes in patients whose memories were improperly encoded neurologically. Mathematically these have low reproducibility rates in different spatiotemporal fields and are immoral since they involve spamming repetitive text, video, or method actors at the subject irrespective of agreement to inclusion. SDL warrants mention because many of these experiments involve teaching the subject a skill in a drug altered state and finding they cannot repeat the skill sober in a lab which is similar to learning a sport outside of a vacuum in varying pollen or mold environments (12).

One challenge while learning complicated aerial maneuvers is muscular pain and bodily injury acquired from overusing small, less worked muscles. Schools in psychology and physical therapy designed several surveys in the late 20th century to standardize information collected on athletic injuries into data readily computed as summary statistics for larger samples and publication to discover or disprove prevalent approaches to teaching athletics for most people. One such study from 1992 developed the Sports Inventory for Pain (SIP) which is a 25 question scale examining psychological categories through five pain scales and a final composite score. Cronbach's alpha and Analysis of Variance (ANOVA) was the statistic used and resulted in higher decimals acceptable for publication, arriving at the conclusion that the SIP was adequate in measuring an athlete's ability to play while injured. Previous surveys from the 1980's include the McGill Pain Questionnaire (MPQ) or the longer 42 question Coping Strategies Questionnaire (CSQ). The Pain and Impairment Relationship Scale (PAIRS) was used to measure attitude of individuals with chronic pain while the T/F questionnaire from the Controlled Repression-Sensitization Scale (CR-S) was used to minimize the doubt of self-reported surveys

from misguided young people who would risk permanent bodily malady by lying to the athletic trainers about the severity of their injury to return to practice (11). Pain charts are used in clinical processing settings to visually identify where the pain is occurring and the efficacy of the body maps by pediatrics are examined by Canadian and U.S. researchers (1). A user-friendly web based mannequin with several tiers of body parts and follow up questions is developed with tens of thousands of users in an attempt to increase intake speed by researchers from Norway (19).

Researchers from Sweden, Canada, and Australia published an opinion paper in 2014 attempting to clarify language used for sports pain management wherein the term *sports trauma* is a sudden injury event such as a broken leg while the term *sports disease* is defined from overuse syndrome from excessive repetitions resulting in chronic inflammation (22). Although these terms are already well defined, the article provides a launching point for considerations in recording pain. The accumulation of several decades of previous research in more recent language is helpful to speed up conclusions. For the sake of brevity, the numerical scale in our study lumps both terms together with text comments indicating significant one-off bruises, minor tendon tears, or overuse inflammation. The muscular areas in the scale are also generalized to lower the amount of data entry every day.

A survey from 2017 in the United Kingdom sought to quantify the perception of pain in contact sports athletes using the SIP with a 1-5 scale over three time periods at the start, middle and end of the season. They separated contact sports into groups from martial arts, rugby, and American football and included active participants or non-participants who had a bodily injury that prevented them from playing. The two tests at each recording time included placing their hand into nearly freezing water and recording pain every minute for five minutes with a symbolic chart. The second test induced ischaemia and measured blood pressure and handgrip

strength. This was done to use more confident parametric statistical tests that require real world measurements like pearson correlation instead of spearman rank correlation and would allow for more subjective belief in the respondent's truthfulness of their answers. They concluded that since people who were participating in contact sports held their hands under water for longer, they had a higher tolerance for pain (13). As with many psychological or sociological studies, the mathematical results were not much better than random because there are nearly infinite variables that are impossible to quantify because of cost, time, or ethical issues. Taking the results at face value indicates the study more as a reflection on logistical measurements wherein the participants and non-participants have different living environments.

One paper from a Norwegian sports science researcher attempts to quantify overuse injuries and recommended continuous variables to study the functional level rather than the time lost in sports to minimize randomness and prevent long-term injury (2). Another study from European researchers used similar methods with visual scale and cold grip test to compare pain tolerance in soccer, cross country skiers, and long distance runners with non-athletes. A pre-test personality questionnaire was used to improve data quality. Their findings agreed that athletes had a higher tolerance for pain while endurance athletes had a higher tolerance than soccer players. They also commented on the limits of their study because of the small sample size (21). Sports pain summaries are questionable in accuracy of responses since some of the number of participants range from 100-1000. Large surveys are historically difficult because of cost in increasing the accuracy of responses by having the recorder establish a repertoire with each interviewee. Voluntary surveys from electronic and postal mail to attain high sample numbers are error prone because not many people respond to these methods. Engineering and mathematicians scoff at the low R scores reported by social sciences but it's reasonable to assume that studies



from sociology are meant to teach critical thinking skills about statistics to normal students that don't find pleasure in spending their weekends calculating the volume of a time varying section of a dodecahedron noninvasively given a partially visible surface.

## **Methods**

Configurations of the skateboard hardware employed to learn basic tricks are first summarized followed by a description of the general location, time, and date as recorded in tabular format. Skateboard skill is estimated through non-scientific recollection before bodily annoyances from dry skin are examined. Two primary injuries were identified during the several month trial collection period and attempts were made to reduce pain through rest and light exercise. The most obvious injury examined is right leg iliotibial band syndrome (ITBS) or inflammation from overusing the lateral hamstrings and quadriceps muscle while the second abnormality identified is left iliopsoas (IP) hip snap. The IP hip snap was present since youth athletics and is thought to originate from ball kicking related muscle imbalances. Trick techniques are finally examined with two dimensional video stills pointing out progression from stationary to moving ollies.

### *Study period and board setups*

The participant learned stationary skateboarding tricks in a basement in the Midwest from January 21st, 2024 through May 30th, 2024 and will serve as the study period. More time was spent outside during April and May learning tricks while moving in accordance with moderate

temperature and precipitation weather patterns commonly found throughout inland mid-latitude North American climates. Hours were estimated in a Google Sheet, a popular tabular data entry application. From January through March 15th, the exclusive employment of a reused longboarding reverse kingpin truck and 59 millimeter diameter 85a durometer polyurethane double width wheels designed for moderate speed sliding was attached to an inexpensive 8.25 inch width skateboarding deck whose tail had been manually chiseled and sanded down an inch to minimize the random kick from a damaged tail. This board will hereafter be referred to as a cruiser. In the middle of March, the longboarding trucks were replaced with equally tall skateboarding kingpin trucks for more effective practice. A mouthguard was also used to avoid costly dental bills. By April 25th another skateboard was built through internet shopping including standard 52 millimeter 99a durometer wheels, 7.75 skateboard deck, and appropriately sized skateboard trucks. The narrow deck was purchased with the idea that a smaller width would increase foot positioning skill when performing more complicated park maneuvers with a wider 8.25 inch deck. The deck was further modified to move the front trucks back several millimeters for an increased front nose length similar to the cruiser. The included middle cone bushings and bottom washers were replaced with a manually split cylindrical longboarding bushing and improved washer for increased hardness and less board directional stick when landing ollies.

Between 2009 and June, 2024 it is estimated that a longboard had been pushed by the participant 301.25 hours regular stanced and 215.25 hours switch stanced. Longboard slides include 48 hours regular practice and 3 hours switch at moderate rates of speed. From the time periods of 2015-2016 and 2024 it is estimated that 54.25 hours have been spent learning skateboarding tricks regular stanced and 16.75 hours have been spent switch stanced.

Approximately a dozen hours had been spent in 2015 and 2016 learning the shuvit, ollie, and kickflip to minimal success.

Regular stanced heel and tail slide had accumulated over 20 hours each while switch stanced heel slide and tail slide had accumulated one and eight hours respectively. The participant is unable to heel slide regular or switch with the slide glove on the ground but can only tail slide regular with the slide glove down. About one hour had been spent on learning regular manuals combining 2016 with 2024 practice totals. Minimal time had been spent on switch manuals. Once the weather improved in early April, skateboarding outside commenced which included regular and switch hippie jumps and hippie 180 jumps totalling 2 and 1 hours respectively while regular and switch frontside 180 revertsque movements totaled 2 and 1 hours. The end of March saw the addition of learning stationary frontside and backside 180s regular stanced totalling 6.25 and 2.25 hours. It is estimated that 4 hours have been spent attempting to regular stanced kickflip but success has thus far proved elusive.

### *Bodily annoyances*

Through the inclusion of a well lighted mirror in the participant's home, it was discovered that several sites of acne and scalpel hair loss were induced by either static electricity induced dry skin or poor skin moisturizing and itching with a bacteria laden hand. This is relevant to the discussion of skateboarding kinematics since small cutaneous injuries hurt in an exaggerated fashion when falling. At the macroscale, constant itching of dry skin might serve as a distraction to the skateboarding participant while initiating an unnecessary immune response at the microscopic level. The idea of cleaning and moisturizing severely dry cutaneous skin at

joints where pain has become an issue is evidenced by the reduction of pain in the anterior tibia and fibula regions of the skater's leg. The anecdotal evidence might have tangentially related causes such as stretching and reducing the workload toward the middle of the skateboarding trick experiment. More efficient muscular use through healthy skin is supported by how muscular fiber i-band lengthens and shortens as nerve fibers contract with the transmission of electricity across nerve endings and energy dissipated through dry skin or otherwise spent fighting bacteria might hinder performance. The idea of efficient energy use is similar to electrical or communication lines that have faster transmission rates because of low loss of electrical connection. Salt water is a good conductor of electricity compared to water without other elements and another theory supporting the advantages of moisturized skin is that the flow of electrical current would be more effectively directed when compared to dry skin and salt water from sweat. This effect is an untested or thoroughly researched hypothesis but the directly observed benefit is that moisturized skin typically scars less after subcutaneous injury (24).

Small details altering hyper-specific athletic performance occurs in such activities as basketball three-point shooters, american football placekickers, and penalty shootouts in hockey and soccer. Late timeouts, theatrical injuries, and intoxicated spectators are employed as psychological weapons in an attempt to derail concentration. Coaches attempt to mitigate these issues by recreating the environment in practice with auditory speakers. Specifically related to skateboarding, the loud pop of a skateboard might startle and otherwise break the concentration necessary to perform the desired aerial acrobatics. Practicing the jumping motion of the gymnastics-like movement with the inclusion of breaking small sticks served as an auditory and visual que in building muscle memory to perform the desired function. Ways to mitigate the negative auditory sociological effects of skateboarding would be to geographically position

practice sessions close to either construction sites or highways although airborne pollution might damage the lungs and reduce enjoyment. Practicing with the constant background frequency found at interstates might make it more difficult to perform in parks that are more quiet and is different from the intermittent noises on more moderately trafficked roads.

### *Injuries and rehabilitation*

Near the end of the fourth week of April an errant no-comply kicked the board nose into the medial section of the patellar tendon which turned brownish and was thought to cause severe right knee pain for two weeks. Such an injury is inconsequential in normal functioning however it severely limited skateboard practice. The bruise is reminiscent of playing fullback from 13-15 when a helmet would bruise the knee in the same spot while somehow missing the cumbersome knee pads. Investigation included Osgood-Schlatter disease that causes a painful lump below the kneecap while children are experiencing growth spurts though this guess is doubtful as tibial tuberosity is identical on both legs and pain is on the bruise to the subject's right of the patellar tendon. The subject previously reported knee pain while exercising several years prior. As the bruise healed and the patellofemoral issue persisted, other attempts to find the origin of pain were examined.

The first attempt to mediate the issue included general stretching. When the pain persisted, a Google search for lateral knee pain relief directed the subject to perform nerve flossing of the leg muscles to reduce inflammation surrounding the peroneal nerve that runs from the top of the foot up the front of the shin and laterally around the back of the knee (3). This helped immediately in reducing pain while walking and jumping but skateboarding proved

tremendously difficult. The aforementioned football lateral ankle sprain might have been another source of the issue and was subsequently moisturized and stretched. Another injury that was investigated was the AC sprain whose surgery the doctor and participant elected to skip because of long recovery time and the probability that the same injury was likely to reoccur because of lifestyle choices. Since the raised acromion would lower the scapula muscle dropping the serratus anterior and posterior into the abdominal obliques and hip adductors, it stood to reason that this might affect kinematic function of walking and running gait during exhaustion when respiratory and circulatory systems began to fail to deliver adequate oxygen to the skeletal-muscle tissue to hold symmetrical posture. Taping the shoulder in place helped stabilize the arm and torso movements while returning to skateboarding but afterwards the shoulder hurt which made the practice ineffective and not viable for continuation.

Films of professional skateboarders and the participant were reviewed to examine moving ollies and see if the sport itself was to blame or the user. Moving jumps progressed higher and awkward landing frequencies increased as the participant became more exhausted from the two hour sessions. Since purposely hyperextending knees in an exaggerated motion similar to the caved stiff lower knee landings resulted in similar left knee nerve firings as the pain described in the injured right knee, it is agreeable that overexerted ollie lands were part of the issue though the source of the pain was still a mystery. Wildly swinging the arms for balance while overtired would contribute to pulling muscles attached to the knee and is partially responsible for normal movements (4). Once the obliques become strong enough it stands to reason that the physical force would radiate into the lateralis and trapezius where the shoulder joint sprain originally was and settle into the weakest muscle causing pelvic instability.

The primary discovery was achieving higher ollies by technique improvement through squatting quickly above parallel with forward rounded shoulders and jumping slightly diagonally at increased speeds. This squat technique is contrary to standard weight lifting form guidance that stresses keeping the knees behind the feet and outward with an inflated chest and backward positioned shoulders as displayed in the image sets included below in this section. Lifting technique is for weight bearing exercises to reduce injuries. Skateboarding switch is effective in mitigating overuse from squat jumping on the left leg, however it was thought that a broken clavicle from adolescence would lead to identical problems on the right knee besides increased risk of trauma to the exposed appendix and other internal organs. It is tempting to progress through the sport quickly but the chances of muscular damage increases. Professional skateboarders are impressive because they devoted several thousand 10 hour days eating, stretching, and skating without causing permanent muscle damage by attempting a trick outside of their abilities.

Additional thought was placed on the origins of the right knee pain when it occurred to the participant that similar knee pain had started while consuming tobacco and alcohol frequently to reduce stress from working overtime as a janitor. Housemaid's knee is the unofficial term for prepatellar bursitis inflammation because of the sometimes awkward bending in cleaning hard to reach places and often occurs because the person is overweight. These self medication methods are unhealthy for a variety of reasons but the main takeaway is that unhealthy lifestyle contributes to inflammation. The combined stresses from working two jobs along with inflammation from substance use and high salt diet means that skateboarding was not the original cause.

Another possible contributing factor was sitting on the left glute while working a 9-5 job for almost a decade due to the outstretched right arm using the mouse. The elevated AC joint further compounds this left glute sitting position by initializing a stabilizing left arm position. From this muscle imbalance and lack of movement the right tensor fascia latae (TFL) and connecting muscles such as the quadriceps vastus lateralis become weak and subsequently inflamed when exercising. The muscles proximal to the TFL expand under the inflexible IT band and destabilize connective tissue around the lateral epicondyle on the femur bone head. The patellar tendon becomes aggravated and causes the knee pain issue. Paresthesia or cutting off the supply of blood to the leg to the point of numbness can hinder athletic performance (10) which may have played a role in uneven glute muscle development during four months of strength training while working from home during the pandemic in 2020.

The knee pain subsided after cessation of intense work but progression of distance running over three months to 15 miles reinitiated inflammation shortly thereafter, indicating overuse. Although the two issues of AC joint and motor coordination while tired don't help, it was not the original source of knee pain. It was later thought that the origins were through overuse from pushing switch, which is consistent with tendonitis or more commonly called runner's knee. The knee-jerk reaction if extremely mentally tired from working would be to buy braces, compression gear, or beds but the solution that remedied this issue was to rest and slowly increase exercise intensity over several weeks.

*Injuries and rehabilitation for hip snap*



Once the knee pain subsided, the next bodily part that seemed to be anomalous to regular function was a snapping internal hip band on the left leg. This issue has been occurring since the subject's high school years and might be related to the intermittent right lower back pain, though they were not a debilitating barrier to athletic performance. The two common hip snap causes are internal with IP and external with muscles along the iliotibial (IT) band. It was hypothesized that the IP band was causing painless hip snaps over the iliopectineal of the lower pelvis while doing excessively elevated knee and external hip rotations during repeated ultra high ollies with a heavy skateboard. Through the Thomas Test the left psoas was found to be less flexible than the right, lending evidence to an inflamed IP and left lateral pelvic tilt which indicates muscular imbalance caused asymmetrical hips where the left hip is higher than the right. Stretching the entirety of the hip flexor seemed to reduce the issue. The participant was a highschool football placekicker and involved overloading the left hip to kick right footed similar to pushing a longboard for significant hours with body weight on the left quadriceps. Further tests were performed with 20 moderate left footed rugby punts where there was no hip snapping immediately afterward by testing a high raised left knee but 15 harder left punts resulted in more frequent snapping. The right hip also snaps after an identical moderate and hard kick series and excessively high externally rotated knee raises.

Muscles attaching to the left posterior pelvis are unable to hold back the raised knee either from muscle balance or lack of motor coordination and a similar hip snap occurs on the right IP when that knee is consciously raised too high. Low muscular coordination is supported by consistently misstriking the rugby ball on or near the shin. It was then thought to increase left leg coordination and flexibility by kicking tennis and rugby balls and also by pushing the skateboard switch with body weight concentrated on the right hip. Lack of motor coordination is

especially apparent when attempting to learn the kickflip with severely inconsistent left footed board striking. Medial right heel pain occurs after excessive walking, running, or standing and is a result of externally rotating and flattening the right foot while tired. Without conscious thought, the participant casually stands with weight loaded onto the left foot and with a laterally rotated left foot which is what led to this conclusion and fits with the unbalanced muscle theory derived from pushing mainly regular for several hundred hours. Another hypothesis is that driving for an extended period with the right foot rotated to switch from gas to brake while commuting to work and driving around larger cities exploring for several hours a week from 2017-2022 possibly contributed but it is a difficult theory to test and it is much more likely that exercise related muscular imbalance is the cause.

More inquiries found that flexing the left glutes and lower back reduced hip snapping. It was then thought that there was gluteal atrophy and overdevelopment of the left TFL and left vastus lateralis from poor running form and not lifting during the pandemic. Two years of minimal activity during antipsychotic use also contributed to muscle reduction. Delving further into the anatomical processes involved, the muscles attached to the left pelvis have become more flexible and are unable to easily keep their correct physiological positioning while maintaining left footed ground contact because the left hip is slightly raised. This condition is commonly called lateral pelvic tilt. Warming up the glutes prior to exercise seems to eliminate the hip snapping from raising the knee and lowering it. The hip doesn't snap at all when squatting which is one of the final positions of the ollie as the rear leg also raises up during the jumping motion.

The additional stress from athletic overuse tightens the strained muscles and they are unable to remain upright which causes left IP hip snap as the left knee rises higher than 90 degrees and externally rotates (4). The same hip snap occurs on the right leg when the top of the

pelvis dips backwards to gain hyper vertical knee elevation. Hip snap in general is probably a lack of motor coordination whereby overusing the knee inflamed the left muscles and right multifidus on the lower back. The left quad, adductors, and calf are more strong and flexible from the excessive 2024 ollies and the newly built muscles are not yet motor coordinated (4). The lack of coordination is evidenced by missing the rugby ball toward the ankle on the foot, occasionally double kicking the ball off the toe.

Still a third theory arose as the cause of the hip snapping as evidenced by recollection of the process in high school. The right side of the lower lumbar spinae muscles compressed slightly from overloading the right leg during heavy powerlifting squats as a teenager and overdeveloped the left quadriceps and right gluteus maximus. A common failure part is transferring the squat from hamstrings and glutes to the quadricep half way through the motion. Slightly overloading the right leg at this point decreases arched lower back and square shoulders while using the left abductors and right glutes. Pushing the longboard regular stanced most of the time for several years further contributed to the muscle imbalance as did falling and lacerating or bruising the left glutes during downhill longboarding potentially causing muscular fibrosis (6, 9, 14, 18).

Mental stamina seems to fade in and out at 5 second intervals in hyper concentration tasks as judged by the juggling of four balls and supported further by playing musical instruments. That might be a reflection of the nutrient delivery system circulating oxygen to the brain and muscles through respiration and cardiac cycles dictating the speed of transmission for electrical signals in the nervous system which occurs more frequently during the last third of skateboarding practice. The combination of all of these activities results in aggravated proximal lateral quadricep muscles which then shortens further from inflammation. The participant laid in

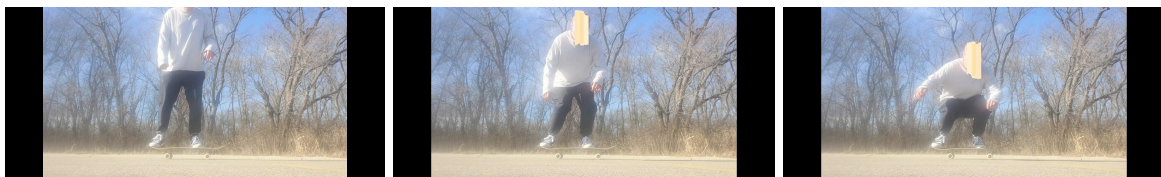
bed primarily on his back for several days while performing minimal upper leg stretching. This reduced knee pain and he was able to return to skateboarding at his leisure. Excessive cardio exercising is the primary issue that contributes to poor form and IT band issues because of a slight leg muscle imbalance. Research revealed that it would be beneficial to strengthen the core with abdominal exercises, left glute through single leg squats, and right quad through practicing switch longboarding, skateboard tricks, and left rugby punts until the muscles are more identically motor coordinated. The laterally rotated right foot could also be mediated through strengthening adductors on that side.

### *Skateboarding trick technique*

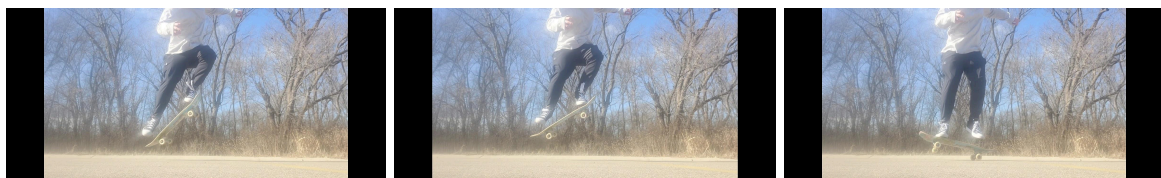
Technique review through self captured still video while learning stationary and moving ollies on the larger cruiser board occurred during February and March. More work was performed while moving around during the month of April and no video was recorded. The last week of April the participant upgraded his setup to a narrower board with symmetrical nose and tail, lighter trucks, and wheels almost half the width of the wheels used on the previous cruiser. The wider wheels polyurethane durometer is primarily intended for sliding down steep gradients at moderate speeds and this change allowed for slow mid thigh ollies before getting hurt from a combination of hastily calibrated truck bushing configuration and over-exertion. Both issues were caused by becoming giddy with excitement.

Each session lasted between 30 and 90 minutes or until ollie height decreased and form dissolved. During these first two months it was noticed that technique ability increased as muscles reacclimated to the movement during the duration of the exercise. It typically took

several ollies to relearn the proper movement before ability slowly disappeared as the subject became tired. By the 5th of April, stationary ollies had become routine while moving ollies were steadily improving. At the time of this writing at the end of May 2024, fast moving ollies still curve slightly to the left and are a function of foot placement, timing, and overdeveloped left abductors in terms of flexibility and strength compared to the other major leg muscle groups. It was discovered doing stationary ollies that kicking more with the front foot's heel uses the guiding gluteus medius muscles and applies to performing moving nollie and switch nollie or nose ollies. A common complaint while exercising is lower back pain above the pelvis' iliac crest and strengthening the attaching gluteus medius eliminates the issue through improved stability. There are two image sequences that are included below that highlight issues that occurred during February while learning stationary ollies. The first set is outdoors and highlights bad form in several areas of the initial squat (*Image set 1*) while the second set of images displays poor left knee height (*Image set 2*).



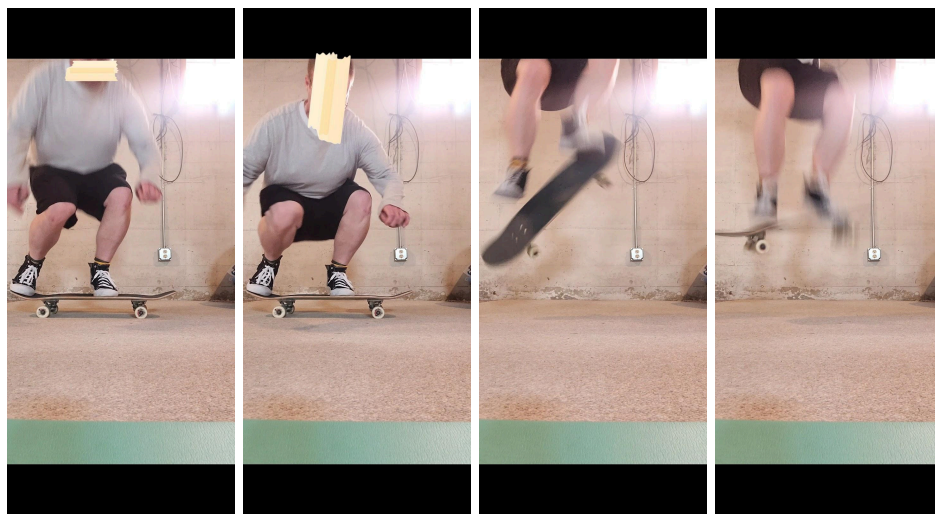
*Image set 1:* Inward back right leg knee cave and squatting too deeply for the movement.



*Image set 2:* The foot is not high enough on the nose of the board at the top of the jump and overcompensates leveling out the tail of the board.

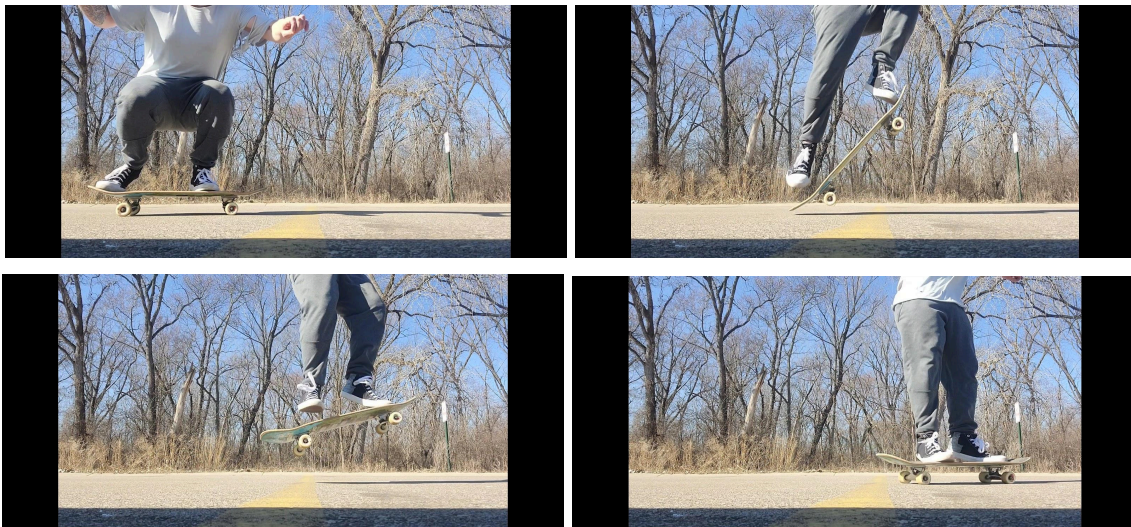
More ollies display a similar right knee cave though it is not the purpose of its discussion. Some of these issues might be a function of poor setup through bad grip tape and an asymmetrical nose to tail ratio. Erroneously flipping the board becomes more of an issue while doing moving ollies when the board flips and the subject lands on their toes stressing the achilles tendon. It is even worse at higher speeds when the board flips into primo and the plantar fascia muscles at the bottom of the feet land on the side of the board. Wearing solid plastic sole inserts to keep the foot arched while performing tricks and pushing regular and switch are essential to build foot muscle thickness through repetitive muscle tearing and avoiding issues like plantar fasciitis which typically stem from excessive standing, walking, and running. Practicing getting into primo and landing looks stupid but increases the skill necessary for proper board control.

The frequency of improved stationary ollies increased from the middle of February until the participant could consistently perform the movement. About three weeks later a stationary ollie occurred with excessive rear knee cave or knee valgus and subsequent slight board tilt (*Image set 3*). Slight board tilt might be a result of performing too frequent ollies and the form should be avoided to minimize risk of abductor injuries.



*Image set 3:* Another proficient ollie near the end of February, this session the subject tried inwardly caving the tailside knee for higher jumps contributing to clockwise board rotation.

Several sessions of moving ollie attempts occurred with minimal improvement and significant soreness from poor athleticism. The next series of images was one of the more improved moving ollies with good front foot to nose tip and leveling of the board (*Image set 4*). Unfortunately the ollie occurred toward the end of two hours skating when the muscles were exhausted leading to bad toe placement, externally rotating the front foot, and subsequently bringing the forward leg backwards to land. The problem of a left diagonal landing becomes apparent as speed increases which is consistent throughout the recorded videos.



*Image set 4:* A rare and more improved ollie from the first month learning tricks with the front foot externally rotated causing leftward landing.

Recording ceased around the end of March as the weather improved and the subject could now ollie consistently at slow speeds. This meant that ollies could now be attempted over curbs, down inclines, and over larger irregularities in paved side streets while pushing. Another ollie attempt had several technique issues, the most glaring is the excessive depth in squatting prior to

the ollie. In sports like powerlifting the glutes have to break parallel with the hip to count as a successful motion and this is probably a habit from that time. Although several street skaters appear to be squatting that low to log high ollies, they are also positioned more forward facing and have far superior balance through practice. A three quarter squat depth and jump was employed after a two week rehabilitation in the middle of May with several successful curb and drainage cap clearances.

## **Results**

After the patellar tendon became sore and skateboarding ceased, several charts were developed to track the activities for the month of May to chronicle the rehabilitation steps required for future overuse injuries. The first section examines the perception of pain and nutrition datasets in their entirety as tables to describe how information was collected. The next section summarizes the information with graphs by grouping the body parts or nutrition categories into each day's mean and exploring them individually. Another series of graphs displays the duration of each activity. The final section uses each day's textual descriptions to more accurately judge the numerical data's effectiveness in summarizing the exercises.

### *Pain and Nutrition Tables*

The Sports Inventory for Pain (SIP) and similar pain questionnaires are used by sports psychologists after an interview to directly compare tolerances for pain between demographics (2, 11, 13, 21) while a pain chart is used as a body map or manakin in a clinical study for patients



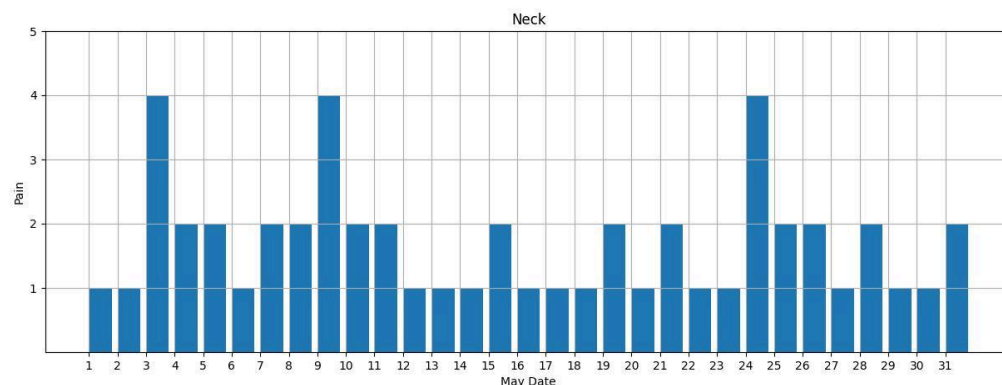
to identify the bodily part where the injury is located (1, 19). A 0-5 scale from high pain to low pain in 17 areas was developed to view the perception of pain along with a similar category measuring stamina. One table tracked pain induced from exercise while another summarized diet and weather information using calories and an arbitrary macronutrient scale.

### *Pain Scale*

The perception of pain is subjective from person to person depending on environment and background. Even more difficult is attempting to define the origin of pain as Delayed Onset Muscle Soreness (DOMS) from exercise or from falling. Large bruises from kicking the board into calves, ankles, or thighs would cost the body more nutritional resources to repair by extending the standard inflammatory response to heal both the board lacerations and the small tears in muscular fibers that occur from exercise. One way to counteract this data collection issue was to include text notes which are included in the next section. Another issue was consistency in defining knee or quadricep pain since the lower quadricep muscles eventually turn into tendons and attach at various points around the patellar. For the sake of data collection brevity, the right or left limb was not included as numerical columns but were specified from the participant's view in the text notes since the subject and author are the same person. Chapter 12 specifically defines the lateral lower vastus lateralis and rectus femoris pain as quadricep pain but this chapter categorizes it as knee pain. The bar charts for neck, shoulders, trapezius, gluteus, knees, and ankles are included because they exhibit consistently high levels of pain. The bicep was not worked frequently during this month and is included to display low amounts of pain.

The rest of the data is not displayed because they are unremarkable. These include head, latissimus dorsi, chest, abdominals, lower back, groin, quadriceps, calves, feet, and stamina.

As displayed by *Figure 1*, the neck is a body part that contains several muscles that become sore very easily. On May third and ninth, the neck was scored as a four and indicates very high pain. The activities that were completed one day before these dates include handstands, which were practiced to build muscle in anticipation of falling on the upper body. The 24th scored a similar four and occurred after three days of increasing exercise intensity with skateboarding and then longboarding twice. Shoulder muscle areas also scored fours on these days (*Figure 2*) while the trapezius muscles scored fours on the third, ninth, and 31st. Between the 25th and 31st, there were five practice sessions for juggling with four taking over an hour. The 29th and 30th also had switch stanced longboarding practices and these two activities are thought to have been the cause of highly rated trapezius pain on the 31st (*Figure 3*).



*Figure 1: Neck pain for May, 2024.*

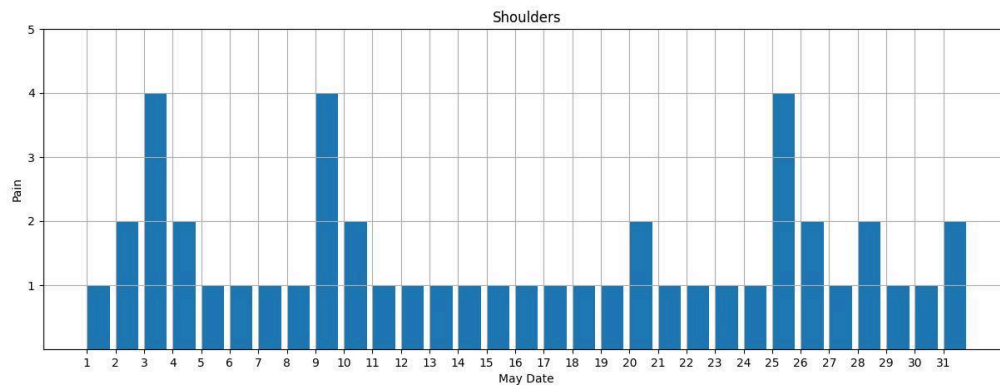


Figure 2: Shoulder pain for May, 2024.

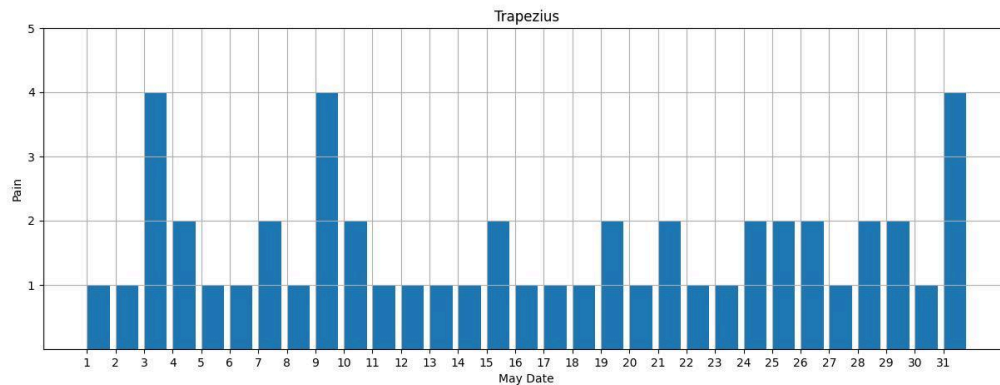
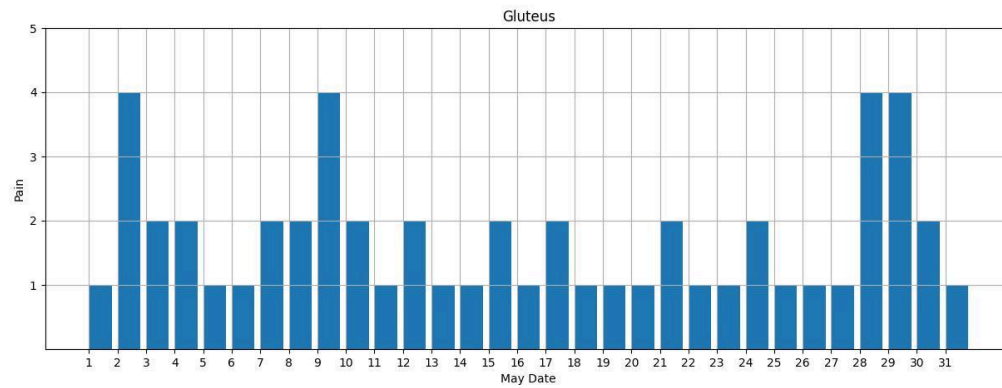


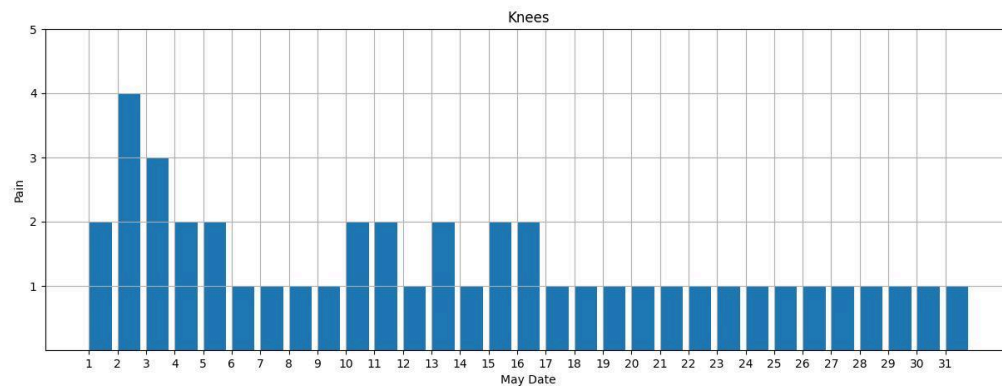
Figure 3: Trapezius pain for May, 2024.

The cause of highly scored pain for the Gluteus muscles on the second of May was from falling onto a partially flipped truck while practicing ollies on the new skateboard setup April 30th (Figure 4). The new board was smaller in all aspects with greater nose and tail angle that facilitated higher jumps unaccustomed to the user. The left abductor bruise took approximately two weeks to fully disappear and the ensuing accumulation of similar bruises contributed to pelvic instability and right lateral knee and ankle pain (Figure 5 and Figure 6). The abnormal pain on the ninth is from plyometric exercises the previous days along with practicing single leg squat jumps onto sticks and up curbs to mimic the sound and feel of ollies. Pain on the 28th and

29th are readily attributed to hour-long skateboarding outside on the 25th and in the basement on the 27th. An example of a muscle group that was worked infrequently is the bicep (*Figure 7*).



*Figure 4: Gluteus pain for May, 2024.*



*Figure 5: Knee pain for May, 2024.*

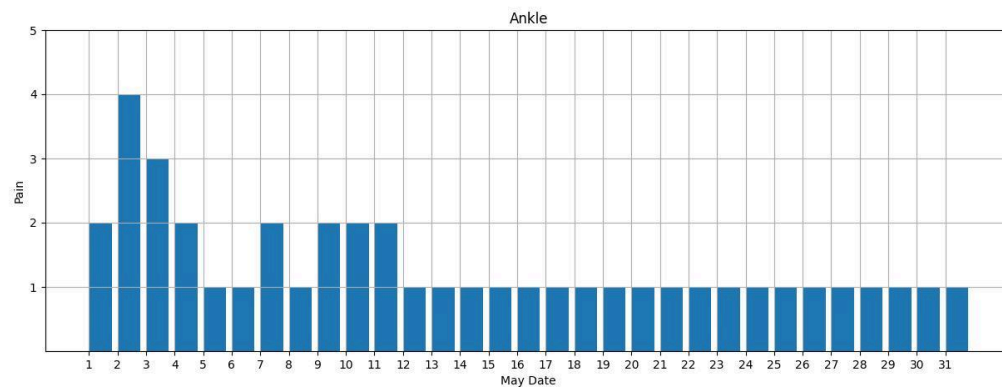


Figure 6: Ankle pain for May, 2024.

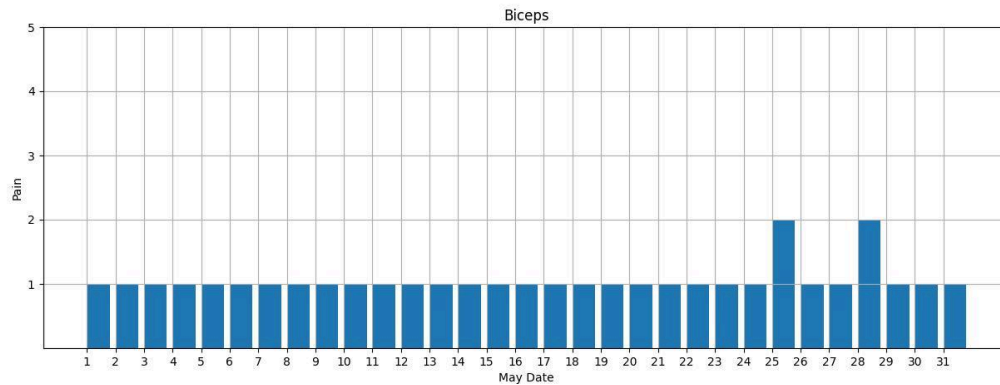


Figure 7: Bicep pain for May, 2024.

The third to final and penultimate graphs summarize the 17 parts into six areas split into upper body (Figure 8) and lower body (Figure 9). Upper body contains the *upper back* values for latissimus dorsi, trapezius, and shoulders, *arms* with chest, biceps, and triceps, and the *head* that describes head and neck pain. The lower body includes the *core* for abdominals and lower back, *upper legs* contain the gluteus, groin, quadriceps, and knee, while the *lower legs* describe feet, ankle, and calves pain. These two graphs appear relatively “U” shaped spiking near the beginning and end. Since the data collection period began when the participant’s right lower quadricep was unable to perform skateboarding techniques, it stands to be the reason that lower body pain was highest the first few days and returned on the ninth, 15th, 24th, and 28th after progressively increasing the exercise intensity.

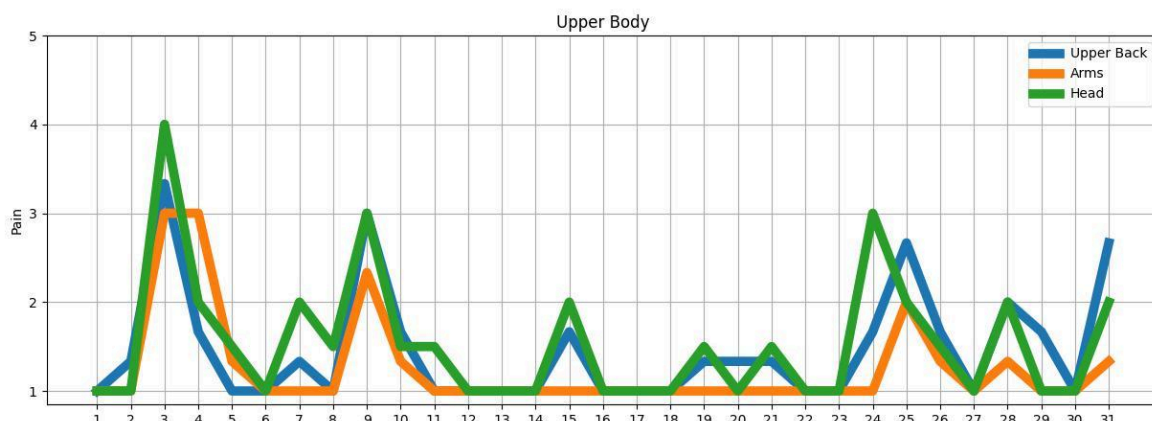


Figure 8: Upper body parts averaged into three groups for May, 2024.

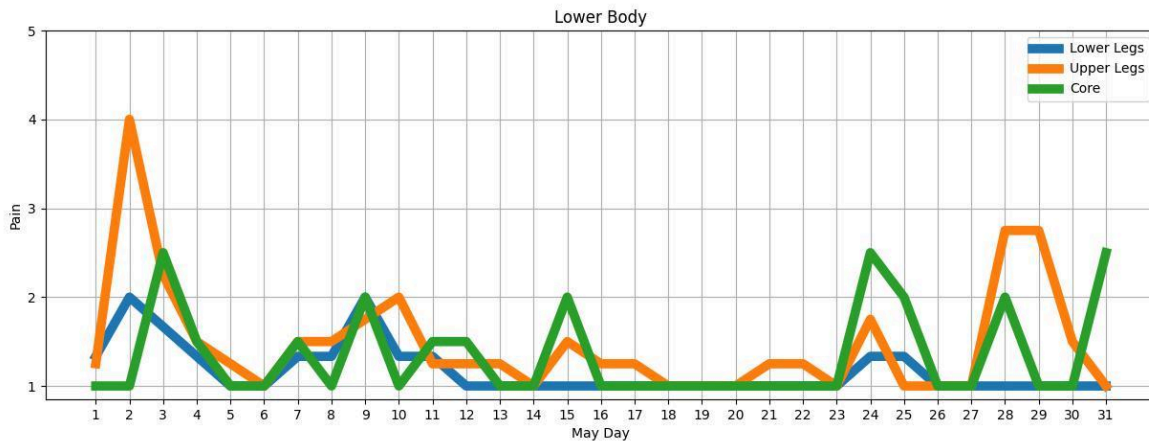


Figure 9: Lower body parts averaged into three groups for May, 2024.

The final graph displays 17 categories summarized into two lines based on daily mean split by upper and lower body as previously described. Stamina is also included and was not statistically modified (*Figure 10*). Lower body pain appears related to upper body pain, when arms were exercised with standard weight lifting since the legs were excessively sore while stamina dips during the three previous dates listed. Pearson correlation was calculated for calories and alcohol but were unrelated since there is usually a delayed effect and the data collection period was during an abnormal low alcohol consumption recovery time. Spearman's correlation was researched but not included since the remaining non-parametric variables display a delayed effect and are under the 30 values usually required for a more robust calculation. Further data collection to examine the relationship between pain, exercise type or duration, and nutrition is warranted to further statistically describe muscular pain that develops with inflammation in the 1-5 days after exercise.

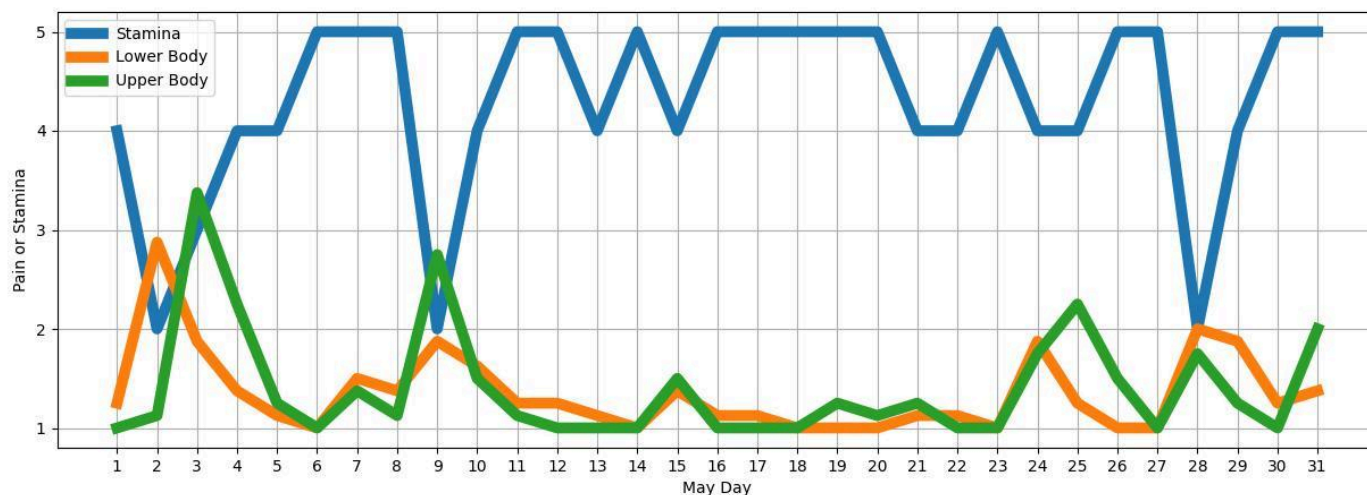


Figure 10: The daily mean of grouped values for May, 2024.

## Nutrition

After falling repeatedly on the gluteus, it was decided to reduce exercise while the bruises healed by maintaining minimal amount of movement. Calorie intake was consistent during this time (Figure 11) and body weight dropped from 210 pounds in late March to 195 by the end of May. Alcohol intake was also consistently low (Figure 12) but was probably attributed to consuming a cannabis concentrate pen along with high pollen counts and comfortable weather.

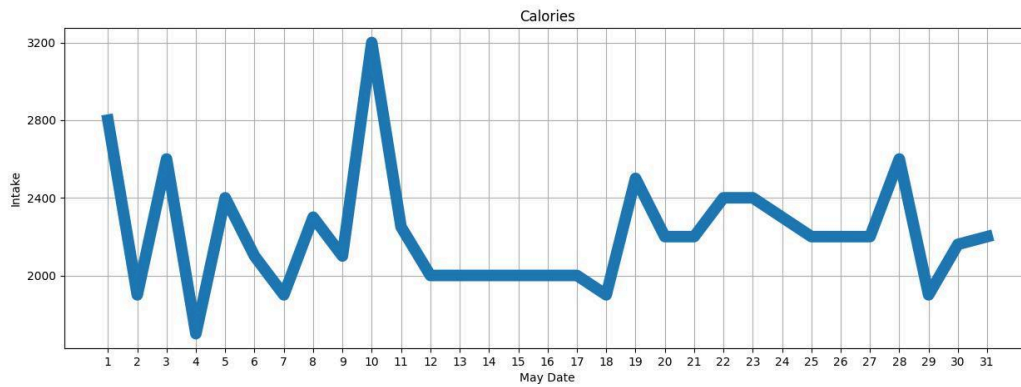


Figure 11: Calorie intake during May, 2024.

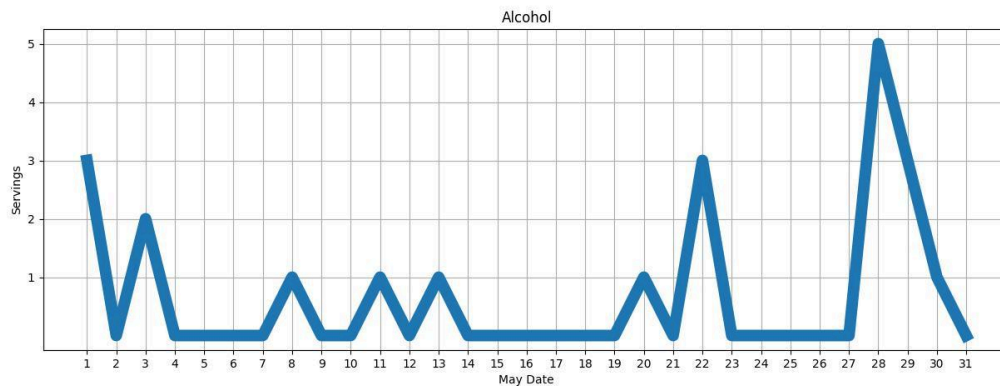


Figure 12: Alcohol intake during May, 2024.

The data collected for nutrients was almost redundant since high amounts of salt, protein, fat, or carbohydrates nearly always indicates high amounts in all of the categories (*Figure 13*). Dietary exceptions to this general statement include vegetarianism or intentionally inducing ketosis which respectively makes protein or carbohydrate intake lower. There was a rare period of no exercise from the 13th until the 17th when bodily soreness became irritating and it was thought that no movement would allow time for inflammation to decrease (*Figure 14*). Otherwise exercise movements remained consistent during this period. By definition DOMS



indicates soreness one or several days after the exercise event and there were only 31 days of information collected, meaning that there is not enough information to use parametric statistics such as Spearman's Correlation for exercise with body part pain to summarize this data collection.

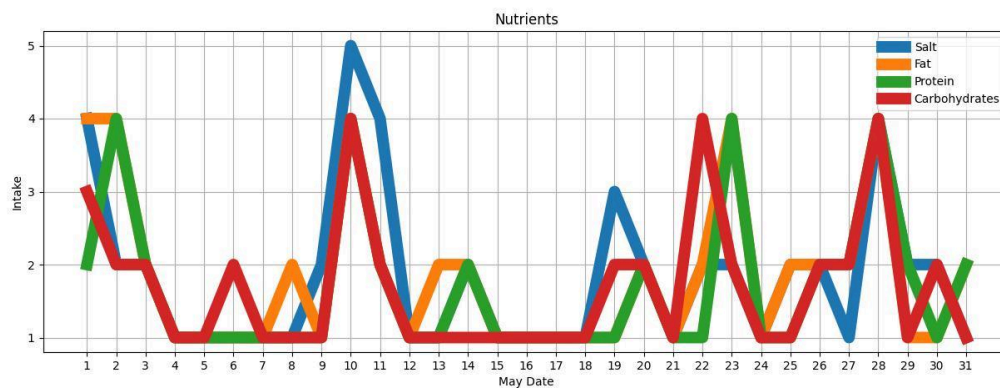


Figure 13: High and low estimates for macronutrients for May, 2024.

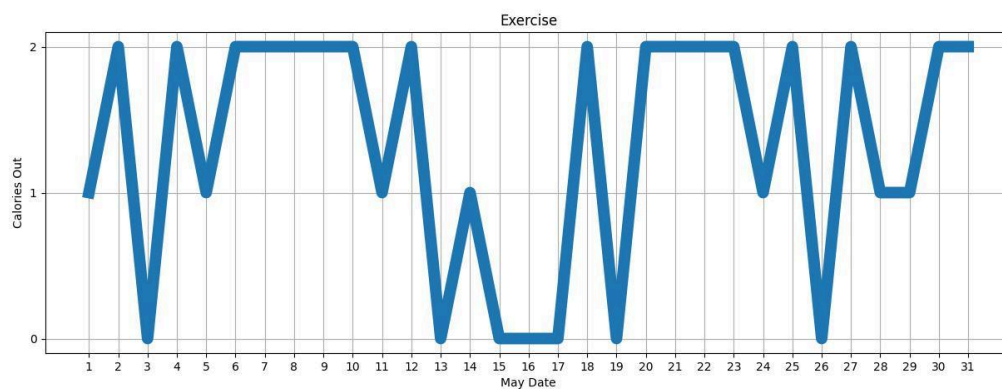


Figure 14: High and low estimates for macronutrients for May, 2024.

### Activities and Duration

Several graphs were developed that summarize the frequency of activity and total sum of each Activity's duration. The bar chart of each recorded activity is displayed in *Figure 15*.

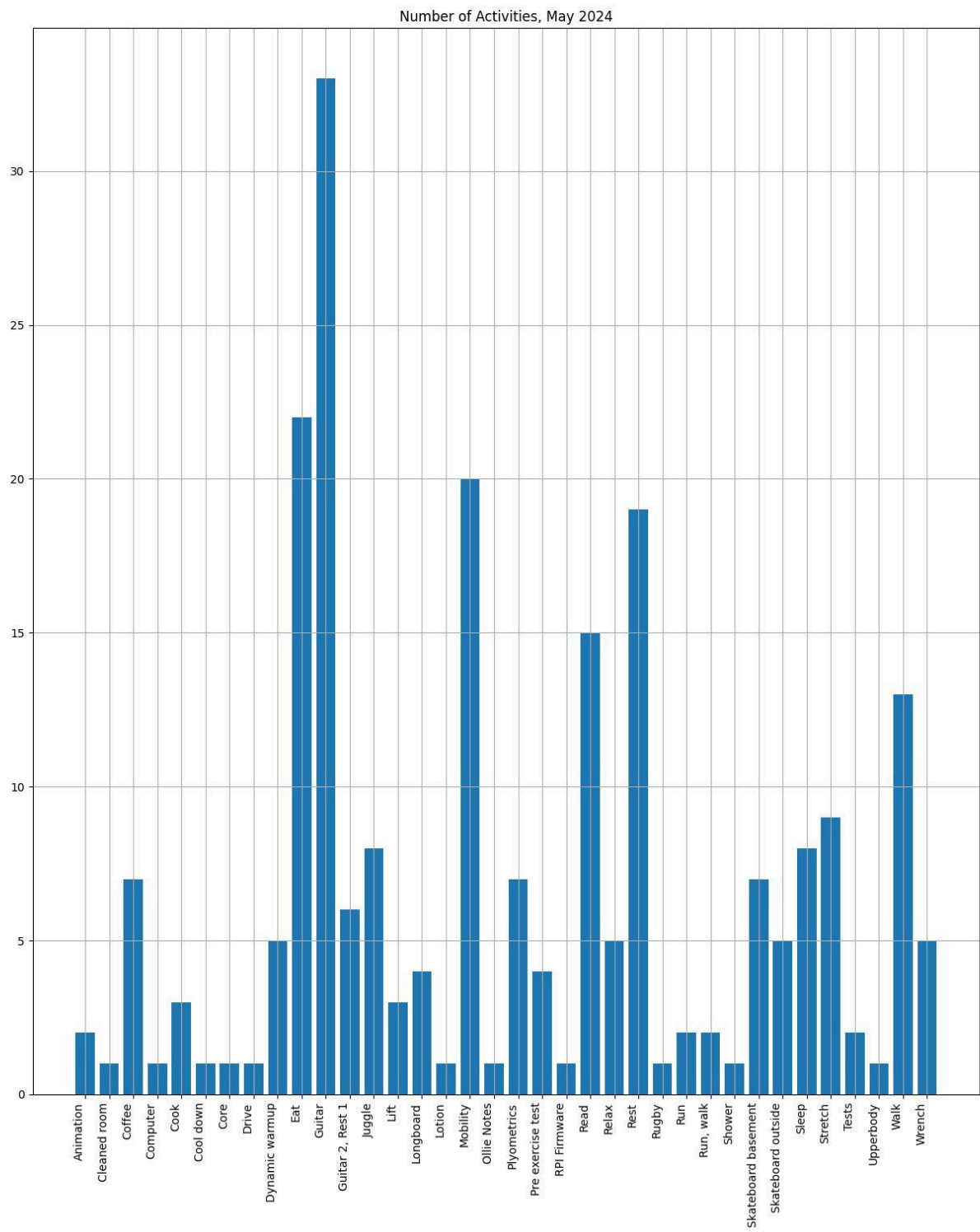


Figure 15: Activity frequency for May, 2024.

When the same activity appeared on multiple days, they were binned into the same category because this was a haphazard record and doesn't warrant graphical summary. One week of data collection was completed with excessive accuracy and accounts for Sleep appearing seven times despite the date range extending 31 days throughout May. Five of the most frequently occurring non-exercise related activities include Guitar, Resting, Eating, Mobility, and Coffee and are consistent with the purpose of this data collection while recovering from excessive skateboarding. Reading was also a common activity while researching information to reduce inflammation and heal damaged muscles. Another bar chart displays the total duration of each Activity in hours (*Figure 16*).

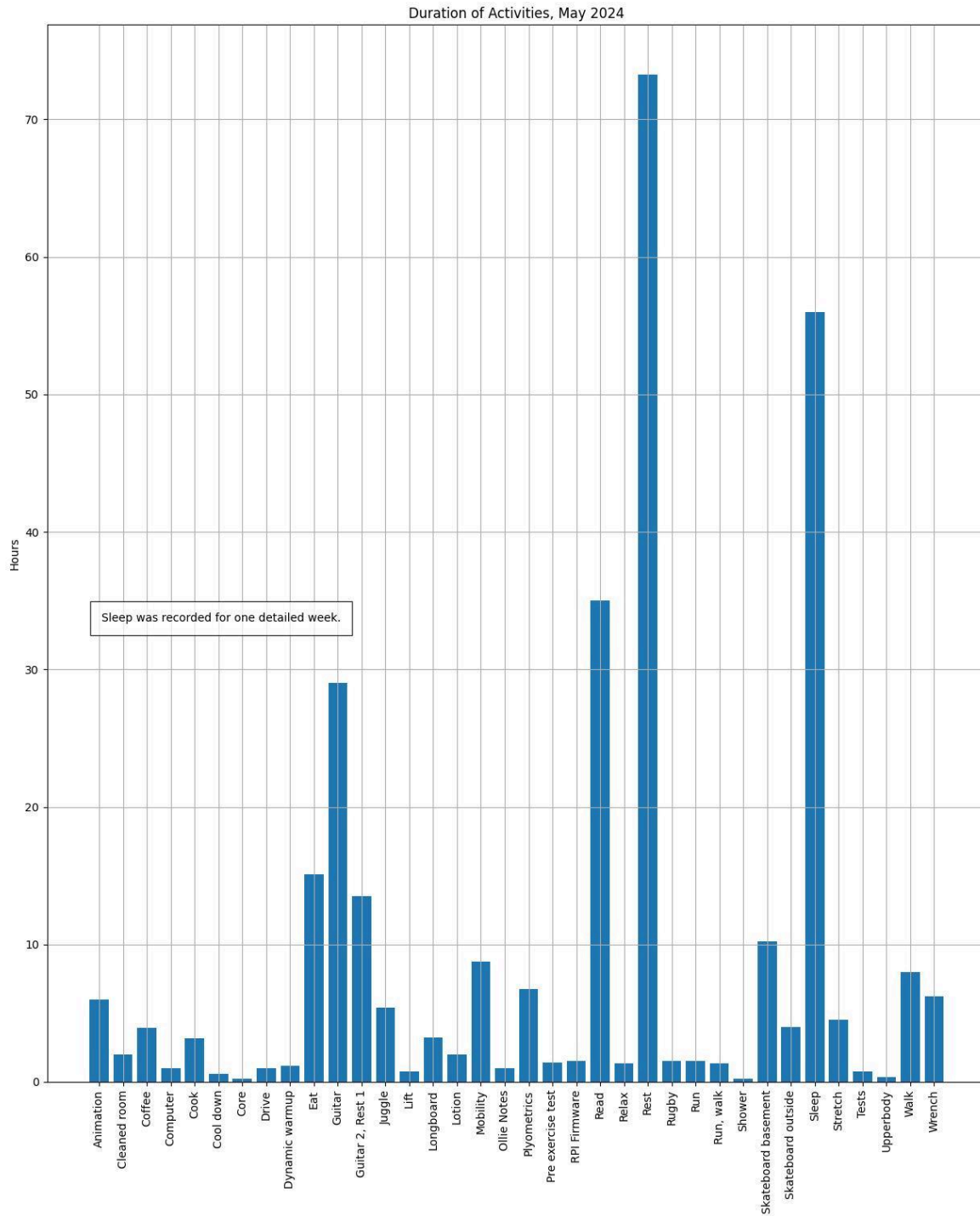


Figure 16: Duration of each activity for May, 2024.

This graph displays the differences in data collection for Rest and Sleep. Rest was collected for the full 31 days with over 70 hours compared with Sleep that was collected for seven days with over 50. The other Activities that accumulated the most hours include Eating, Guitar, Mobility, Skateboarding basement, Walking, and Wrenching. Guitar and Resting as an activity included playing the guitar for 10-15 minutes, then zoning out for 10-15 minutes before repeating and is included as a rough estimate for practice time since the entirety of the hour block wasn't spent strictly playing guitar. Briefly looking at the information it would appear that most of the time was spent playing guitar, sleeping, and eating without understanding the context of the information where the purpose of this month's data collection was to efficiently recover from over exercising. Skateboarding in the basement and wrenching on the skateboard were included to think about skateboarding without subjecting further bodily harm.

### *Text Summaries*

During the end of the last week in April using the new skateboard, a harder fall occurred while performing several moving ollies in a row as a result of a combination of less familiarity with the narrower deck and lighter trucks and wheels while also being tired from over an hour of continuous skating. The injuries sustained were a large lateral left abductor bruise over the gluteus medius that took 11 days to fully heal. The same skate session accumulated the aforementioned medial knee bruise distal on the right patellar tendon that occurred from the nose of the board during an attempted no-comply. That bruise took 15 days to heal and is a reflection of injury location healing time. Although less severe, the knee has almost no muscle or fat between the bone and the skin compared with the hip bruise which generated more Newtons of

force but yielded a faster full recovery time because it occurred on a large muscle group. Several thousand calories amid moderate alcohol use were consumed the following day after moderately stretching the legs for over an hour to minimize knee pain before performing 15 minutes of plyometrics and two miles of walking. This caused additional inflammation and brought awareness to the severity of the problematic knee pain.

May 2nd was devoted to stretching and performing upper body exercises with over a mile of walking. Pre-warm up tests by dropping the weight onto a single leg into a half squat were done to estimate leg pain. Two days were devoted to rest and modifying the new skateboard which resulted in alleviating much of the leg soreness. On May 4th several stationary ollies and FS180s were practiced before running and walking two and one miles respectively. The next day a short walk with jumping and skipping that mimicked skateboarding movements was performed to little issue. May 5th also included moisturizing and massaging the entire dermatological organ. It should be mentioned that most of the previous month had been severely dry with low humidity as the northern Mississippi valley climate's pollen peaked with temperatures oscillating around 50 degrees at night and 75 during the day. In addition it was noticed that forcing sleep on the right side stopped the right lower back pain that may have been aggravated by excessive exercise and a left sided sleeping position. The following three nights were slept exclusively on the right side until the left side of the lower back began to have similar issues.

May 6th included 45 minutes of skateboard related plyometrics before running over a mile performing jumps similar to skateboard movements. The next day the left shoulder was taped into place and minimal knee issues occurred during a shorter hour long skateboarding session outside. Another short mile walk to keep the legs mobile while jumping occurred. The knee joint still had issues while landing at exaggerated angles. The shoulder began to tighten up

later that afternoon and a ball and slingshot were used to perform under shoulder motions. This was done to avoid rotating the entire shoulder muscle and causing pain. On May 8th a half an hour of plyometrics and upper body followed by a lighter 2 miles run and 1 mile walk bouncing a tennis ball for mobility happened. Stretching occurred later that night to help sleep.

May 9th the body was very sore primarily in the glutes and upper body from the previous few days. Over an hour of skateboarding while stationary was performed to test the knee function. A tennis ball was either bounced or juggled while walking three times over the next four or five hours. Hip snap was investigated and stretched for IP band relief. The following day a short walk and run while juggling occurred before over an hour and a half of left footed rugby kicks and short sprints. This assisted with relearning motor coordination in the newly developed lateral quadriceps and abductor muscles. Stretching also occurred that night, concentrating on the IP and TFL. May 11th had several stretching instances and tennis ball rehabilitation walks while exercising the core and glute muscles with bodyweight exercises. The next day tennis ball rehabilitation and skateboarding outside occurred with more pacing between several ollies. May 13th was devoted to not moving. On May 9th-10th several thousand calories were consumed from fast food pizza resulting in salt intake. An inability to consume enough water to replace sweat coupled with almost no fiber from the large volume of airy yeast pizza inflamed the lower colon and caused kidney pain. From May 13th-19th fiber and potassium from various beans and fiber from whole grain sources were consumed which eliminated the digestion issues.

On May 14th, one and a half hours of stationary skateboarding occurred with several ollies and frontside and backside 180s both regularly stanced and switch. More work began in developing foot muscle strength by practicing getting into and out of primo. Walking and juggling was also performed before resting the next day. May 16th psoas exercises were included



before resting. The next day one mile was walked while kicking a tennis ball before performing several stationary ollies and pacing a 15 minute skateboarding session ollieing over sewer caps and doing reverts and 180 jumps. Faster ollies toward the end resulted in clockwise rotations of the board which were landed slightly to the left where the root cause is poorly placed front toes. May 19th was spent walking and stretching the IT bands which would ultimately alleviate the entire left knee pain issue. Over stretching the right IT band caused a similar pull on the patellar tendon in the knee.

A micromanaged schedule was kept from May 20th through 26th and is a general summary of the activities of the previous several months. The morning included waking up at 0800 and cooking for 30-45 minutes and eating higher fiber foods. Coffee was consumed about an hour after eating before playing an instrument for 30-60 minutes. 15 minutes of relaxation occurred before testing the legs with either a tennis ball or rugby ball. Plyometrics, skateboarding, or free weight exercises occurred for an hour before stretching for 15-60 minutes and eating for an hour. Resting occurred for 3-6 hours before eating again and testing mobility by walking and juggling. 15-45 more minutes were spent stretching before playing guitar for an hour and sleeping by 2300.

The next week was less detailed but most of the same activities were performed. Juggling four balls had increased from several catches to over 30 during the two weeks of rehabilitation. Skateboarding trick ability progressed from bunny hop stationary ollies and moving rocket ollies at the end of January to slow mid thigh ollies and faster jumps over curbs by the end of May. Stationary shuvits became high flipped pop shuvits along with learning stationary front and backside 180s. Regular manuals and both stanced hippie jumps and 180 jumps were also learned

while awkwardly landing several slowly moving regular frontside 180s. The landing of the hollowed kickflip remained elusive.

Instead of drinking 10-14 alcoholic beverages a week as occurred from the start through early May, intake was minimized to several per week before binging at the end. Body composition also was reduced from 217 to 205 pounds in about two months which fits within the recommended guidance for safe weight loss of about a pound per week. From the ten days of alcohol consumption, six of the days had excessive calorie intake while three of the days high sodium fast food meals were consumed. The first ten days of May exercise hurt tremendously which probably contributed to eating more food while May 11th-18th had minimal calories while not moving for several days and performing rehabilitation exercises. The period of May 19th-May 30th witnessed moderate calorie intake ranging between 1900 and 2400 excluding an erroneous day on May 28th with 2600.

Basal metabolic rate (BMR) estimates seem to vary wildly because of the difficulty of obtaining a robust sample and humans begin to conserve energy as starving is initiated as a survival method. Guessing calories burned is also a difficult task without access to things like accurate body fat percentage aquatic scales, continual heart rate monitors, sleep studies, and photogrammetric or magnetic resonance imaging quality controlled by more intrusive volumetric tissue sample methods. Medical data with precise measurements is highly sensitive and the potential for misuse makes it a prime target for theft. Luckily most people shared their superficial information two decades ago on social media websites and biometric information one decade ago with heart rate and sleep cycles through smartphones and watches. An effective strategy for weight loss is to be unemployed, keep calories between 2000-2200 and burn between 300-700 every day.

## Conclusions

In a sport like skateboarding where small adjustments severely impact performance, small details such as excessive salt, poor sleep, and low fiber can become a barrier to improving because it lengthens recovery time from bodily injuries or lowers your concentration. Pushing long distances on a cruiser switch and regular is an essential skill in developing thicker plantar fascia muscles to avoid catastrophic foot issues. Rotating the forward foot left or right diagonally while pushing targets either the abductors and adductors more thoroughly however testicular torsion is possible with an externally rotated front foot along with knee issues. Skateboarding does not build gluteus muscle mass as effectively as free weight lifts like barbell squats. Primo also helps with foot muscle development and assists with learning to fall with the board while building board control. Technique issues were unearthed for higher ollies, primarily in foot placement. If you want to jump higher in the ollies, go faster with your front toes placed closer to the screws toward the front of the board while jumping higher and kicking the tail more. Guiding the board with the back foot at the top of faster ollies also improves direction.

Newly acquired shin bruises are a good exercise for comparing the psychology of American football offensive line or Rugby forwards with skill position players or backs. The linemen and forwards think the skill position and backs are weaker for resting after similar injuries but tendon bruises are debilitating to fast directional changes when compared with explosive stationary movements of linemen. Emphasis should be placed that skateboarding tricks are plyometric exercises and not continual cardio. Once the participant gets tired form disappears

with the left knee over raising and the right knee caving in the back. It should also be noted that you will likely break or dislocate a bone or joint participating in this sport. Added pressure to perform while participating in skateboarding in a group is not ideal for people unable to accept teasing when resting injuries and permanent bodily damage might occur.

The problem with more complicated statistics on this dataset is that the pain scale is not real world measurements, therefore nullifying more solid parametric tests such as correlation. The second problem is that the two real world measurements for number of alcohol servings and calories ingested usually have a delayed effect. Since there are only 30 observations, this would fall below the minimum amount needed to use parametric statistics but is the equivalent of stating that drinking alcohol makes people hungry. Muscular pain from exercise is also usually delayed 24-48 hours and could be summarized by using non-parametric statistics such as a delayed Spearman's Rank correlation but also suffers from having insufficient data. Although this was a data collection error, the conclusion is that 100 additional days of observations were to be accumulated and opens the possibility of running filling or predictive simulations with statistics such as the Autoregressive Integrated Moving Average (ARIMA). There is also seasonal ARIMA which attempts to make predictions along specified weather or climatological patterns. More accurate historical weather information including temperature and humidity would need to be included. The time of day was recorded in the dataset and has the potential to identify ability and circadian rhythm. Such information would have to be ground truthed with actual measurements for use in an academic study.

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