Amanda Campbell

"The Chaplain of the New Left": Reverend Richard Moon's Community of Influence and the 1968 Memphis Sanitation Workers' Strike

Faculty Sponsor

Dr. Aram Goudsouzian

Abstract

When 1300 sanitation workers went on strike in Memphis in 1968, many of the city's clergymen led the organizing effort that eventually settled the strike in the workers' favor. One of the only white clergymen to vocally support the strikers was Reverend Richard Moon, the Presbyterian chaplain of Memphis State University. Moon's meaningful relationships to other Memphis ministers and his connections to students through his role as the campus chaplain at MSU shaped his involvement in the sanitation strike, more than a Christian conviction or Presbyterian theology. He followed the lead of black ministers and distanced himself from white organizing efforts; he encouraged student involvement in the strike and championed continued student leadership after the strike was over. The Church, in fact, was shaped more by the activism of Moon and other socially-minded ministers than he was by any doctrine or theology.

At a Memphis city council meeting on March 5, 1968, Presbyterian minister Reverend Richard Moon read a Bible passage and shocked councilmember Gwen Awsumb. Awsumb later recalled:

> *The passage was from Jeremiah where the people tried to get their leaders to do something—whatever it was at the time. And the end of the long passage had something to do with the leaders being deaf and they could not hear the people say "We will burn his city down." And he clamped the Bible closed, turned on his heel and went away… I was just horrified… for him to participate to this extent was appalling to me.*[1]

This meeting was three weeks into the sanitation workers' strike that would be Martin Luther King, Jr.'s last civil rights campaign. The 1968 strike, which came after the Voting Rights and Civil Rights Acts, proclaimed to the nation that the movement was not complete. The strike would later become historically recognized for the "I Am A Man" placards carried by marchers. As Laurie Green explains, the slogan was "a claim to freedom" that "protested the supervisors' paternalism."[2] Many Memphis ministers, including Moon, were supportive of the striking workers. Moon raised money for strikers' families, joined with the strikers in their daily marches from Clayborn Temple to City Hall, and negotiated with city officials on behalf of the strikers.[3] By April 16, when the strike had ended, Moon had been maced, arrested, and had lost twenty-two pounds in a hunger strike.

The strike was not Moon's first involvement with racial justice in Memphis, and he did not see it as the end of his role in the city. Moon's meaningful relationships to other Memphis ministers and his connections to students through his role as the campus chaplain at Memphis State University shaped his involvement in the sanitation strike, more than a specific Christian conviction or Presbyterian theology. He followed the lead of black ministers and distanced himself from white organizing efforts; he encouraged student involvement in the strike and championed continued student leadership after the strike was over. The Presbyterian Church would be significantly shaped by the activism of Moon and other socially-minded ministers. Moon's motivations for involvement in the Sanitation Strike grew from his connections to activist colleagues in the city and activist students at Memphis State far more than his connections to the Presbyterian denomination. His activism, however, made way for important changes in the denomination.

Moon was primed for involvement in civil rights when he arrived in Memphis in 1964 because of his earlier involvement in nonviolent campaigns in Louisville, Kentucky. He prioritized getting to know leaders of the black

community when he first moved to Memphis and read "Dr. Stewart's study of the urban poor in Memphis" as a way of learning about the city.[4] Memphis itself also had a long history of church-led activism. In 1947, Memphis's National Association for the Advancement of Colored People (NAACP) chapter established a Church Department. In a letter to local ministers, the branch leaders stated, "We are well aware that from the very beginning, the NAACP has had the active assistance of thousands of church-people, including ministers, priests, rabbis, bishops, and heads of great religious organizations."[5] By the 1960s, the Memphis NAACP branch was supported by "sophisticated leaders with college degrees" including Maxine and Vasco Smith.[6] Organizing was not new to young Memphians: Students at Lemoyne College requested a charter for a collegiate NAACP chapter in 1940.[7] When the sanitation workers decided to strike, Moon and the Memphis religious community in general had experience in social justice campaigns. In Memphis in 1968, Moon was surrounded by activists.

Moon worked in several churches before his assignment as Presbyterian

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[1] Joan Turner Beifuss, At the River I Stand (New York: Carlson's Books, 1989), 156.

[2] Laurie B. Green, Battling the Plantation Mentality: Memphis and the Black Freedom Struggle (Chapel Hill: University of North Carolina Press, 2007), 253.

[3] Michael Honey, Going Down the Jericho Road: The Memphis Strike, Martin Luther King's Last Campaign (New York: W.W. Norton, 2007), 392.

[4] Richard Moon, interview by Joan Beifuss, Judy Schulz, and Jerry Viar, 29 May 1968, recording and transcript, Mississippi Valley Collection, MSS 178, Container 19, Tape 55 and Container 23, Folder 180, page 6, Ned McWherter Library Special Collections, The University of Memphis, Memphis, Tennessee.

[5] Sample Letter [September 1947], Box II: C185, Branch Files- Memphis, Tenn. IV, 1947-1950. National Association for the Advancement of Colored People Administrative Files, The Library of Congress Manuscript Division, Washington, D.C.

[6] Honey, Going Down the Jericho Road, 30.

[7] Letter, From Daisy E. Lampkin to Lucille Black, Box II: C185, Branch Files- Memphis, Tenn. I, 1940-1942. National Association for the Advancement of Colored People Administrative Files, The Library of Congress Manuscript Division, Washington, D.C.

chaplain at Memphis State University began in 1966. His first choice for ministerial appointment was a downtown church where he could engage in social work. He began his career as the pastor of Emmanuel Presbyterian, which he called "a purely white church," where he started an after-school program for black elementary schoolers.[8] This program upset many of the white congregants, and Moon took a position at Parkway Gardens Presbyterian where he pastored a black congregation on an interim basis before starting at Memphis State. Moon cultivated an important friendship with his Parkway Gardens successor, Reverend Ezekiel Bell, a young black minister and son of a sanitation worker. The two often marched side-by-side during the strike, and Moon "followed the leadership" of black ministers, including Bell, in joining the Committee on the Move for Equality (COME).[9] COME was founded and headed by black ministers Reverend James Jordan of Beale Street Baptist Church and Reverend James Lawson of Centenary United Methodist Church. It formed during a meeting on February 23, 1968. After a march from City Hall that afternoon, the police had maced the strikers and their allies, including Moon, Bell, and other ministers. The group came to lead the organizing of the strike over the next eight weeks, holding strategy meetings every evening after the nightly mass meetings held for the strikers and their families. Moon served with COME throughout the strike and even called it a second job.[10] Because Moon had intentionally patterned his ministry after Bell and others, he joined in the strike through COME.

Whereas Moon sought to closely follow the lead of black ministers, he intentionally distanced himself from most white ministers and characterized their actions as too moderate. Most white ministers were involved in the all-white Memphis Ministers Association (MMA), not COME. Moon viewed the MMA as too moderate, and he distrusted their resistance to integrate. There were many organizations involved in the sanitation strike. According to Michael Honey, this made it hard to unify the movement in Memphis. The NAACP, the MMA, and COME all pulled the movement in different directions.[11] Moon often remembered his involvement with the strike and with COME as being "the only white face in a sea of black."[12] Reverend Malcolm Blackburn, a white minister who pastored the black congregation at Clayborn Temple was involved in COME throughout its operation as well. Blackburn sat permanently on the COME strategy committee, while Moon served only periodically.[13] Nonetheless, Joan Turner Beifuss maintains that Moon bore the brunt of the white community's resistance to white ministerial support of the strikers and that "his presence was always conscientiously reported on by the press."[14] Moon reported that he and his wife also received many threatening phone calls that attempted to intimidate him into ceasing his involvement with the strike.[15]

Moon distanced himself from the white ministers involved through the MMA. On April 5, 1968, the day after Dr. King was assassinated, the MMA had organized a prayer service at St. Mary's Episcopal Cathedral. It held a meeting after the service and decided to march to the mayor's office to express the ministers' continued commitment to a resolution of the strike. Moon was not, however, satisfied with this march. He recalled,

> *I all of a sudden found myself with my mouth open and saying to them, "Gentlemen, we have just heard the mayor say the same thing that he has been saying for the last eight weeks. He has not changed his mind. He is not going to change his mind...until the strike is over. And I'm going to stay without eating. Anyone who wants to join me, can." This was an emotional response to the situation. It wasn't so much a response to the mayor, as it was a response to the ministers.*[16]

Moon lost twenty-two pounds over the next two weeks. His presence at City Hall was a daily act of of insistent pressure during these weeks and a reporter remarked: "That was the first time I can really recall [Mayor Henry] Loeb showing real strain."[17] He started eating again only after the mayor finally caved to the demands of the union and strikers. Moon admits that "it might have been a strategic error on my part" to inconvenience Loeb by occupying his office while asking to negotiate with him. To balance pressure and convenience, he urged those who wanted to join him to do so from their homes or a church, not to join him in his City Hall stakeout.[18] Because of

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[8] Moon, interview by Beifuss et al, Folder 178, page 2-3.

[9] Moon, interview by Beifuss et al, Folder 178, pages 22-23.

[10] Moon, interview by Beifuss et al, Folder 179, page 4.

[11] Honey, Going Down the Jericho Road, 253.

[12] Moon, interview by Beifuss et al, Folder 178, page 31.

[13] Malcolm Blackburn, interview by David Yellin and Anne Trotter, May 24, 1968, transcript, Mississippi Valley Collection, MSS 178, Container 23, Folder 77, page 2, Ned McWherter Library Special Collections, The University of Memphis, Memphis, Tennessee.

[14] Beifuss, At the River I Stand, 181.

[15] Moon, interview with Beifuss et al, Folder 179, page 18-19.

[16] Richard Moon, interview by Joan Beifuss et al, Folder 180, page 4.

[17] Beifuss, At the River I Stand, 322.

his distrust of white ministers' commitment to the cause, he was inspired to more radical acts, like the spontaneous hunger strike.

Moon's more immediate community—the students of Memphis State University—also contributed to the particular way he engaged with the strike in 1968. The sanitation strike was a watershed moment for student activists on Memphis State's campus because it was the first time black and white students worked together to affect change in their community.[19] Black and white students tried to form an interracial student organization, the Student Alliance, in the fall of 1967, but the Student Government Association (SGA) denied the group a charter. The Black Student Association (BSA) had been organizing at the same time as the Student Alliance. Shortly after the Alliance failed, the BSA was granted its charter. The year 1968 was turbulent for college campuses across the country as the civil rights movement and anti-war protests reached a fever pitch, but Jeffery Turner argues that Southern activism looked different than activism at Ivy League institutions or in the burgeoning Free Speech Movement at University of California-Berkeley. Southern students organized differently because many of their institutions were dealing with the drama of integration throughout the 1950s and 1960s in ways that Northern schools were not.[20] Turner points out that white students in the South rarely had any interracial experiences before arriving at integrating campuses, and that the "many levels of closeness" necessitated by school integration gradually led to less resistance to integration and more embracing of racial activism among some students.[21]

Memphis State adheres to these larger trends of increased interracial activism. The strike was a crisis moment for both white activists, who supported the unions, and black activists, who highlighted the more explicitly racial elements of the strike.[22] While the student newspaper, Tiger Rag, largely failed to claim a position on the strike until early March, an editorial praised students who were involved in campus marches in support of the strike on the front page of its March 8 issue. The same issue, however, also included a letter to the editor from a student who was "revolted" by the BSA's call to support the strike.[23] While MSU had one of the largest black populations of any southern, historically white university, the restrictions the administration placed on its black students robbed the university of genuine integration.[24] Even in this shift to greater interracial activism, most students were still suspicious of marches and demonstrations.

The Student Alliance was the first attempt at an integrated student organization since the Memphis State Eight arrived in 1959, with two notable exceptions: The Catholic Student Center and the Presbyterian Westminster House.[25] Moon inherited an integrated ministry from Reverend Gene Ether-

idge in 1966, and he was committed to supporting black and white student activists. Moon began working with Edwinna Harrel in September 1967 to start the Student Alliance until the SGA withheld its charter in March 1968.[26] He also aided the BSA, inviting the leaders to use the Westminster House as a printing press for their handbills and meeting announcements. Eddie Jenkins, one of the early organizers of the BSA called Moon's help throughout the 1967-1968 school year "invaluable."[27] Moon's connections to Jenkins and Harrel are indicative of his larger desire to connect with radical new left students on campus, who he claimed were all black. To Moon, the white activist students were not as engaged as white students at Berkeley and Columbia but he predicted that there would be many more radicals on MSU's campus in the future.[28] Moon's involvement with these new left students prompted his interviewer, Joan Beifuss to ask him,

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[18] Moon, interview by Joan Beifuss et al, Folder 180, page 7.

[19] Jack Lorenzini, "'Power Concedes Nothing Without a Demand': Student Activism at Memphis State University in the 1960s," Ph.D. dissertation (Memphis: University of Memphis, 2014), 143.

[20] Jeffrey A. Turner, Sitting in and Speaking Out: Student Movements in the American South: 1960-1970 (Athens: University of Georgia Press, 2010), 280.

[21] Turner, Sitting in and Speaking Out, 114.

[22] Lorenzini, "'Power Concedes Nothing Without a Demand,'" 146.

[23] Tiger Rag, "Campus Awakens," vol 31 (1967-1968), no. 33 (March 8, 1968), page 2, from Ned McWherter Library Special Collections, University of Memphis, Memphis, Tennessee.

[24] Lorenzini, "'Power Concedes Nothing Without a Demand,'" 41.

[25] Lorenzini, ""'Power Concedes Nothing Without a Demand,'" 34, 24.

[26] Moon, interview by Beifuss et al, Folder 178, page 11.

[27] Eddie Jenkins, interview by Joan Beifuss and Walter Wade, January 7, 1969, transcript, Mississippi Valley Collection, MSS 178, Container 21, Folder 104, page 24, Ned McWherter Library Special Collections, The University of Memphis, Memphis, Tennessee.

[28] Moon, interview by Beifuss et al, Folder 178, 9-10.

> "You are—besides serving as the chaplain of the Presbyterians—you are also chaplain of the New Left?" Moon laughed, but gave a serious answer: "I've never considered myself to be the chaplain of the Presbyterians, because there's no way anymore to talk to students as Presbyterians… I'd like to take the name 'Presbyterian' off the board out front and put, 'University pastor available.'"[29]

As Moon became increasingly more involved in campus activism, he distanced his role from the theology and doctrine of the Presbyterian Church. He was not the chaplain of Presbyterian students, but of the university, and particularly the student activists. He made no excuses for his involvement with the BSA or the Student Alliance yet he was willing to give up ties on campus to his denomination by welcoming all students—not just Presbyterians. He recognized that for students at Memphis State, he was far more useful as an ally to their activism than as a preacher of a particular theology. He recognized that students in 1968 were no longer cleaving so closely to their denominations, but instead seeking practical guidance for interacting with the world, especially in the crisis moment of the strike. In this way, Moon's involvement with student activism affected how the Presbyterian church appeared on campus. Moon's ministry was more racially integrated, more activist, and more ecumenical than a traditional Presbyterian chaplaincy because of his relationships to students on campus. For his involvement in the strike, Moon's activist organizing mattered more than his faith.

Shirletta Kinchen argues that the 1968 Sanitation Strike was the first activation of the Poor People's Campaign and one of the civil rights movement's first clashes between the church-led movement and new ideas from Black Power activists.[30] Young people in Memphis challenged the authority and methods of the clergy leaders of the strike. The BOP began to assert its influence more strongly during the strike. Though James Lawson included a few BOP members on the COME board, the group often felt ignored.[31] The most storied clashing of old and new power in the nine-week strike was the march-turned-riot on March 28. This march was originally scheduled for March 22, but was snowed out. It was to be one of the largest because of the participation of Dr. King and other high-profile Southern Christian Leadership Conference (SCLC) leaders. The march devolved quickly as some marchers used the sticks that held their placards to smash windows.[22] Dr. King blamed the violence on the BOP, though it was more likely the fault of poorly trained marshals and restlessness.[33] Around this time, rumors circulated that members of the BSA at MSU were plotting to assassinate Mayor Henry Loeb, and several student leaders of the BSA lost their downtown jobs as a result.[34] Rumors like this strained the relationship between BOP and COME.

Moon, however, offered no harsh words toward BOP or the Invaders, the militant arm, in recalling the drama of March 28, when he himself was teargassed. Instead, he called attention to the violence inflicted on children not only at the march, but at Hamilton High School that day, concluding "My assessment is that the police overreacted."[35] He also "insisted that the marginalization of BOP in the strike strategy sessions led to the disturbance."[36] BSA leader Ronald Ivy was marching with Moon and Reverend Ezekiel Bell when they were attacked by the police. Moon did not marginalize the youth activists. In fact, when asked about the future of the Memphis movement, Moon identified the BOP as key leaders: "they are the people doing the community organizing right now."[38] Moon embraced his unofficial title, Chaplain of the New Left, with some vigor. It changed how he engaged with the strike. Rather than fearing the encroachment of young activists, he embraced the changes they brought.

Richard Moon's relationships to his community of clergy friends and students influenced his involvement in the sanitation workers' strike more than his relationship to the church. His involvement in the strike, however, did add to a trend among socially-involved ministers in influencing the church. The 1960s were a turning point in the white southern church. The civil rights movement offered a significant challenge and opportunity for

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[29] Moon, interview by Beifuss et al, Folder 178, 10.

[30] Shirletta J. Kinchen, Black Power in the Bluff City: African American Youth and Student Activism in Memphis, 1965-1975 (Knoxville: University of Tennessee Press, 2015), 3.

[31] Anthony C. Siracusa, "Nonviolence, Black Power, and the Surveillance State in Memphis's War on Poverty," in Black Struggles for Freedom in Memphis, Tennessee, ed. Aram Goudsouzian and Charles W. McKinney, Jr. (Louisville: University Press of Kentucky, 2018), 292.

[32] Siracusa, "Nonviolence, Black Power, and the Surveillance State in Memphis's War on Poverty," 285.

[33] Kinchen, Black Power in the Bluff City, 46-47.

[34] Lorenzini, "'Power Concedes Nothing Without a Demand,'" 155-56.

[35] Moon, interview by Beifuss et al, Folder 179, page 21.

[36] Kinchen, Black Power in the Bluff City, 65.

[37] Lorenzini, "'Power Concedes Nothing Without a Demand,'" 144.

[38] Moon, interview by Beifuss et al, Folder 180, page 13.

the Southern Baptist Church and the Methodist and Presbyterian Churches in the south, which had been historically defined by their support of slavery and segregation. These three churches had all split with their Northern counterparts before the Civil War and were each, to some extent, reconciling in the mid-20th century. This reconciliation involved a reordering of church priorities of which segregation was the keystone. Individuals affected great change in their churches during the civil rights movement.

In 1962, twenty-eight white Mississippi Methodist ministers published a statement titled "Born of Conviction" in support of school integration. The group published the statement after violence erupted on the University of Mississippi campus upon James Meredith's integration of the school.[39] Their letter was perfectly aligned with the Methodist Church's official stance on school integration, but the denomination had not yet been faced with an obvious opportunity to enforce this position, and many Mississippi Conference leaders strongly opposed the letter writers' stance. These Mississippi leaders claimed that it was not the church's place to offer an opinion on what they took to be a political matter, but as Joseph Reiff argues, the Born of Conviction ministers offered "a prophetic rejoinder" of spiritual and political matters with their letter.[40] By speaking out as ministers, they forced a political issue into a clerical collar and insisted their denomination deal with the issue of integration more explicitly. Their letter offered a challenge to the governing body of the Methodist Church and to their individual congregations. The denomination responded by supporting the ministers and offering them posts outside of the South. Many congregations pushed back, though, and nineteen of the twenty-eight signees left Mississippi by 1964.[41] Reiff insists however, that the real story lies in the ministers that stayed with their congregations. Reverend Nick Nicholson, a progressive minister who did not sign the letter sought to help his congregation navigate issues of race by remaining in Mississippi, rather than departing the south.[42] Many churches like Nicholson's then went on to have meaningful conversations about race and faith.[43] These Mississippi Methodists, both those who signed and those who did not, worked to change the role of the Church from within.

In a similar way, religious activists in Memphis in 1964 and 1965 forced the hand of the Presbyterians by kneeling-in outside the Second Presbyterian Church each Sunday for months to challenge the church's segregation policy. In the case of Second Presbyterian, the clergy and many congregants were in favor of allowing the interracial group of student kneelers into worship, but the controlling body of the church, the Session, was adamantly opposed. The clergy and the activists were in line with the denomination, whose official stance on integration had been supportive since 1954 when they were the

first white denomination in the South to support *Brown v. Board of Education*.[44] But, like the Methodists in 1962, they had yet to enforce this position. Stephen Haynes argues that the kneel-ins were the push the Church needed to fully support integration: "Segregation in individual congregations was generally not a denominational concern until the kneel-in era, when unwelcome visitors drew attention to exclusionary policies."[45] The denomination was particularly pressured at this time because Second Presbyterian was scheduled to host the 1965 annual denomination meeting. After many other Presbyterian churches across the South condemned the actions of the Second Presbyterian Church, the governing body finally pulled the conference from Memphis, thereby effectively condemning the Second Presbyterian's actions. In February 1965, the congregation voted to change the election process of elders in order to vote out the segregationist elders who had previously held lifetime appointments. A week later, eight elders resigned in protest, and the kneelers were welcomed into worship the following Sunday.[46] These activists, many of whom openly declared their own religious convictions as reasons for kneeling-in at Second Presbyterian, were prophetic voices that brought a shift in the way the Presbyterian Church understood its role in society.

Moon offered another prophetic voice just a few years later by getting involved with the sanitation strike as a minister. Though he did not speak about a Christian conviction when remembering his involvement in the strike, he was tied to the Presbyterian Church because of his identity as a minister. The denomination did not push him to march with the strikers. Yet, like the Born of Conviction ministers and the Second Presbyterian

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[39] Joseph T. Reiff, Born of Conviction: White Methodists and Mississippi's Closed Society (New York: Oxford University Press, 2016), 57.

[40] Reiff, Born of Conviction, 205.

[41] Reiff, Born of Conviction, ix-x.

[42] Reiff, Born of Conviction, 250.

[43] Reiff, Born of Conviction, 130.

[44] Stephen Haynes, The Last Segregated Hour: The Memphis Kneel-ins and the Campaign for Southern Church Desegregation (New York: Oxford University Press, 2012), 86.

[45] Haynes, The Last Segregated Hour, 91.

[46] Haynes, The Last Segregated Hour, 205.

kneelers, he offered a witness and a challenge. In 1983, the Southern branch of the Presbyterian Church re-merged with its northern counterpart to form the Presbyterian Church of the United States. This marked a shift in the denomination from one that openly supported slavery and segregation to one that could align itself with national ideals and embrace integration. It was the overt actions of ministers and other religious people engaged in causes of racial justice that forced the denomination to rethink its ideals and act out those new ideals in the world.

Two months after the sanitation workers had returned to work, Beifuss asked Reverend Moon if he planned to stay in Memphis. The Presbyterian minister had lived in Memphis only four years, but his experience in the strike was perhaps harrowing enough to suggest a dramatic change. And yet, the minister planned to say in Memphis because he recognized that no other city was free of the struggles that Memphis faced in 1968: "no matter where you go nowadays—and I mean all over the world—you're going to be faced with conflict and these kinds of human problems. So you might as well stay where you are and fight the battle where you are."[47] His connections to black ministers and activist students kept him tethered to the city. These relationships inspired his involvement with COME and his positive response to student protestors. Moon's activism, like others before him, affected change in the Church more than the Church affected changes in him. Rather than letting his Presbyterian chaplaincy inform his activism, Moon instead let his chaplaincy of the new left inform the Church.

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[47] Moon, interview by Joan Beifuss et al, Folder 180, page 13.

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Alexis K. Nelson graduated *magna cum laude* from the University of Memphis in May 2019 with a major in pre-health studies and a concentration in exercise, sport and movement sciences. She also earned the Undergraduate Research Scholar and University Honors with Thesis designations. Throughout her time at the University of Memphis, she has been in multiple research projects in the Musculoskeletal Analysis Laboratory under Dr. Douglas Powell and has presented her work at several regional and national conferences including the National Conference of Undergraduate Research, the Midsouth Biomechanics Conference, and the American College of Sports Medicine. Alexis did her internship in January under the supervision of Dr. Shalini Narayana in the Neuroclinic at Le Bonheur Children's Hospital. She will continue with the University of Memphis as a Graduate Research and Teaching Assistant in the Health Studies department to pursue a graduate degree in Health Studies. With her combined experience from Le Bonheur and the University of Memphis, she hopes to continue her education after the graduate degree to apply to a neuromechanics doctoral program to pursue a career in clinical research.

Alexis's paper received a *Quaesitum* best paper award.

Alexis Nelson

Effects of Stride Length on Knee Loading in Simulated Obese Populations

Faculty Sponsor

Dr. Douglas Powell

Abstract

Walking is part of our daily activities. Increasing body mass potentially increases biomechanical mal-adaptations including reduced step length (SL), and increases joint loading (JRF). The purpose of this study was to determine if acutely added mass (AM) or SL change knee JRFs during walking. Hypotheses included: AM will alter SL, reduced SLs will increase JRFs, and AM increase JRFs. Fourteen participants performed eight trials in four experimental conditions including two variations of SLs, and AM. 3D kinematics and ground reaction forces were collected simultaneously using an 8-camera motion capture system (240 Hz, Qualisys, Inc.) and force platforms (1200 Hz, AMTI, Inc.). Visual 3D was used to calculate joint angles, moments, powers and JRFs. Reduced SL had greater joint flexion angles, peak extension power, and JRFs than AM condition. It was concluded that reduced SLs are associated with greater JRFs while AM in isolation does not alter joint biomechanics.

Introduction

According to the National Institute of Diabetes, 70% of the United States population is overweight or obese ("Key Health Data About Tennessee," 2018). Tennessee itself has the sixth highest rate of obesity in the nation. Further, Memphis had an obesity rate of 33.8% in 2015 (Diseases, 2017; Ruiz, 2012). These statistics reveal that Memphis is one of the most obese cities in America ("Tennessee State Obesity Data, Rates and Trends," 2018). From 1990 to 2015, the obesity rate in Tennessee increased by 20% and continues to increase (Ruiz, 2012). As a nation, the prevalence of obesity is predicted to be 30-37% in men and 34-44% in women by the year of 2020 (Adams et al., 2006). Increasing obesity rates result in secondary increases in cardiovascular and musculoskeletal disorders which result in a concomitant increase in healthcare costs. Obesity-related medical expenses totaled an average of $26 billion dollars per year in the United States from 2005 to 2011. Medical expenses are greater for obese individuals, who are estimated to pay an additional $2,700 to $3,600 per year compared to healthy individuals (Cawley & Meyerhoefer, 2012). As a country, state and city, we are collectively affected by obesity.

Obesity is a scale of excess weight that is associated with adverse health effects (Bessesen, 2008). A widely accepted way to assess excess weight is through a body mass index (BMI). BMI is calculated as the quotient of an individual's body mass divided by their height (in meters) squared (Haff & Triplett, 2016). BMI is used to categorize individuals as underweight (< 18 kg/m2), normal (18 kg/m2 – 25 kg/m2), overweight (25 kg/m2 – 30 kg/m2) or obese (>30 kg/m2). A positive correlation exists between BMI and mortality rates with greater BMI associated with a higher mortality rate (Adams et al., 2006). It is suggested that even modest increases in body weight have negative effects on lifespan (Figure 1), and that the serious negative effects of increasing body weight are not solely due to higher BMI values, but are the result of secondary effects of obesity including metabolic disorders, hyperlipidemia, hypertension, and diabetes (Gregg et al., 2005).

Though obesity has deleterious effects on cardiovascular and metabolic health, obesity is also known to lead to chronic musculoskeletal conditions such as osteoarthritis (Felson, Anderson, Naimark, Walker, & Meenan, 1988; Mohammed, Al-Numair, & Balakrishnan, 2015). Osteoarthritis (OA) is a progressive degenerative disorder of the articular cartilage around a joint: in this case, the knee. Twenty-seven million people in the United States have been diagnosed with OA, equating to more than 8% of the national population ("NIH fact Sheets – Osteoarthritis," 2018). OA accounts for an estimated $10 billion in healthcare costs each year (Bliddal, 2008). Every 5kg

of weight gained increases the risk of osteoarthritis by 36% (Lementowski & Zelicof, 2008). Increasing body mass is associated with greater mechanical loading to the lower extremity. This mechanical loading is created through biomechanical maladaptations such as a reduced step length. Reduced step lengths equate to a greater step width and increased knee joint load.

Obese populations demonstrate aberrant gait biomechanics. Specifically, obese individuals walk with shorter step lengths and greater step widths compared to healthy individuals. A shorter step length is suggested to direct the forces of the system in a vertical direction, which may increase skeletal joint loading (DeVita & Hortobagyi, 2003; Westlake, Milner, Zhang, & Fitzhugh, 2013). A larger step width decreases peak knee joint moments and an increase in mediolateral ground reaction forces, causing abnormal motion and loading in the knee joint, and increasing the risk of musculoskeletal insult and injury (Yocum, Weinhandl, Fairbrother, & Zhang, 2018). A knee joint moment is the rotational force applied to the joint. These two factors in combination (increased load and greater skeletal involvement) may underlie the higher rates of osteoarthritis in obese individuals exacerbating a sedentary lifestyle and furthering their obesity.

Mechanically, obesity affects multiple aspects of daily living (ADLs). To participate in ADLs, functional capacity has to be present with a low disability. Functional capacity for individuals overall decreases as BMI increases (Adams et al., 2006). Past research has also found a positive correlation between disability and obesity (Alley & Chang, 2007). Specifically, disability in this case will be defined by the increase in knee OA. The pathophysiologic process of knee OA has been identified biomechanically as an increase in knee-joint forces and knee-joint moments. Past research has examined this through changes in body mass (i.e. weight loss). Knee joint adduction moments have been related to an increase in compressive loads (Andriacchi, 1994), and weight loss has been found to reduce significant compressive knee-joint loads, or forces (Milner, Meardon, Hawkins, & Willson, 2018). Overall, obesity impedes movement, hindering the individual's ability to perform basic, daily activities. Many daily tasks require physical activity, which decreases BMI ratings, obesity, and mortality rates (Sui et al., 2007). A daily task that is available and physically demanding to most individuals is walking. A successful treatment many physicians prescribe to increase physical activity is to increase step goals for obese individuals. In order for obese individuals to increase physical activity per day, walking mechanics are important to examine. Doing so ensures that these individuals do not have secondary effects from an increase in walking prescription.

Though it is clear obesity results in altered gait biomechanics, the role of shorter step lengths on knee joint loading in obese individuals has not been established. Messier et al. (2005) reported that each pound of weight lost results in a four-fold reduction in knee joint load per step during daily activities. It has also been suggested that decreases in weight in combination with increased stride lengths result in substantial reductions in knee joint loading (DeVita, Rider, & Hortobagyi, 2016). In contrast, Milner et al. (2018) has suggested that a shorter stride length would reduce the vertical impulse applied to the knee joint, reducing the risk of developing OA. An important difference in these studies pertains to the population of interest. While Milner et al. (2018) focused on obese individuals at a single point in time, DeVita et al. (2016) performed an intervention study and evaluated gait biomechanics across multiple time points in a repeated measures design. The role of step length in knee joint loading has not been well established. There is a need to investigate the role of step length and increasing body mass on knee joint loading rates during gait. Therefore, the purpose of this study is to (a) determine if acutely added mass (weight vest) results in changes in step length during walking, (b) to determine if reduced step length independently (in the absence of added mass) increases knee joint loading, and (c) to determine if added mass results in an increase in knee joint loading. It was hypothesized that: (a) acutely added mass will result in differences in step length (b) reduced step lengths will result in an increase in joint loading, and (c) added mass will alter biomechanical variables and increase joint loading.

Methods

Participants

The location in which this experiment took place was the School of Health Studies Musculoskeletal Analysis Laboratory at the University of Memphis, Tennessee. Participants visited the Musculoskeletal Analysis Laboratory once for examination and testing. The session's duration lasted from 60 to 90 minutes. Prior to any warmup, measurements or testing, individuals were screened for inclusion in this study through the following mechanisms: providing written informed consent, completing a verbal training history to determine study eligibility, and completing a written Physical Activity Readiness Questionnaire (PAR-Q; Appendix A). For each session, testing occurred in the following order: (1) warm-up exercises, (2) placement of measurement sensors, and (3) completion of walking trials including four experimental conditions involving the interaction of two step length conditions and two added mass conditions.

Experimental Equipment

Anthropometric measurements included age, sex, height, and body mass. The following measurements were recorded using a stadiometer and scale. Following anthropometric measurements, retro-reflective markers were placed bilaterally on the participant's lower extremity including the trunk, pelvis, thigh, shank and feet to measure individual segment motion during walking trials (step length x added mass) using a 9-camera motion capture system (240 Hz, Qualisys AB, Goteburg, Sweden). A pair of force platforms were used to record ground reaction forces (GRFs; 1200 Hz, AMTI Inc., Watertown, MA, USA).

Experimental Protocol

All walking trials required the participants to perform eight over-ground walking trials across a 20-meter walkway in each of four experimental conditions. Experimental conditions include the interaction of two step lengths (natural and constrained, 0.68 m) and two weighting conditions (unloaded and loaded) at the participants preferred walking speed. The constrained step length of 0.68 m was selected based on previously published data for obese individuals walking at a self-selected speed (Devita et al., 2016). The self-selected walking velocity was characterized as the pace at which the participant would normally walk during daily activities. The natural step length condition allowed participants to walk with their chosen step lengths while the constrained step length condition required participants to walk with a step length of 0.68 m as outlined on the laboratory floor using masking tape. The unloaded weighted condition was characterized as the participant walking without additional load added onto the participant's body mass. The added mass condition entailed the participants performing the walking trial with an added load of 20% body mass in weighted plates; the plates were placed into a vest worn around the participant's chest. To ensure each participant qualified as "obese" in the added mass conditions, a BMI calculation was performed with the added load to identify if each participant's new BMI exceeded 30 kg/m2 to classify them in the obese category.

A successful walking trial was characterized by the participant walking across the runway at the prescribed velocity and having the foot of interest fully supported by the force platform in the center of the walkway. Participants completed eight successful walking trials per condition totaling 32 walking trials with 60- to 90-second periods of rest between trials to avoid fatigue. Participants wore their active shoe of choice to perform the movements.

Data Analysis

Data captured from the three-dimensional motion capture system were labeled and exported to c3d file. Visual3D (C-Motion, Bethesda, MD, USA) was used to calculate knee joint angle, moment, and power time-series, as well as the knee joint reaction force time-series. Custom software (MatLab, Mathworks, MA, USA) was used to calculate discrete biomechanical variables during the stance phase of gait, including peak knee flexion, knee joint range of motion, peak knee extension moments and powers, and peak positive knee joint reaction force.

Statistics

Five 2 x 2 (load by step length) repeated measures analyses of variance were used to assess the interaction of mass and step length on the following biomechanical variables: peak knee flexion angles, knee joint range of motion, peak knee extension moments, peak knee extension powers and peak knee joint reaction forces. In the presence of a significant interaction or significant main effect, post-hoc paired sample t-tests were used to determine the source of significance. Significance was set at $p < 0.05$.

Results

Table 1 presents the biomechanical variables of interest for each experimental condition including: peak knee flexion angle, knee joint range of motions, peak knee extension moments and powers and peak positive knee joint reaction forces. In Figure 1, no mass by step length interaction was observed for peak knee flexion angles ($p = 0.524$). The constrained step length was associated with greater peak knee flexion angles than the preferred step lengths ($p = 0.043$). Post-hoc t-tests revealed that peak knee flexion angles were greater in the constrained compared to preferred conditions for added mass ($p = 0.03$), but not the unloaded condition ($p = 0.08$). No effect of mass was observed for peak knee flexion angles ($p = 0.578$). In contrast to peak knee flexion angles, no mass-by-step length interaction was observed for knee joint range of motion in Figure 2 ($p = 0.571$). Further, no main effect of step length ($p = 0.299$) or mass ($p = 0.585$) was observed for knee joint range of motion.

Variable	Body Mass			Added Mass		
	Preferred SL	Constrained SL	p-value	Preferred SL	Constrained SL	p-value
Peak Knee Flexion Angle (deg)	-36.0±12.9	-40.5±7.7	0.04	39.0±10.5	-41.4±7.7	0.52
Range of Motion (deg)	40.4±13.2	43.3±6.8	0.30	43.1±10.1	43.9±4.8	0.57
Peak Knee Extension Moment (Nm/kg)	2.9±2.3	2.3±0.8	0.15	2.4±0.7	2.3±0.9	0.31
Peak Knee Extension Power (W/kg)	6.1±4.2	4.6±1.0	0.04	5.7±1.8	4.8±1.0	0.61
Knee Joint Reaction Forces (N/kg)	7.1±2.0	6.1±1.1	0.02	6.9±2.3	5.4±3.1	0.75

Table 1. Biomechanical variables of interest for each experimental condition

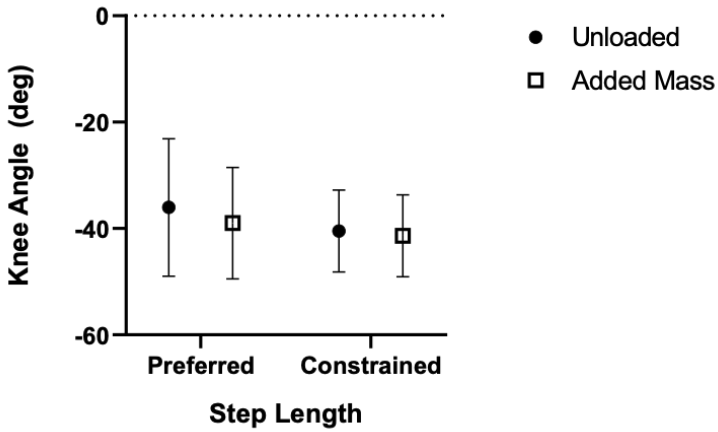

Figure 1. Peak knee flexion (deg) during level walking with increased mass and constrained step lengths. Constrained step length was associated with significant increases in peak knee flexion angles ($p = 0.040$). No changes were observed for added mass ($p = 0.520$).

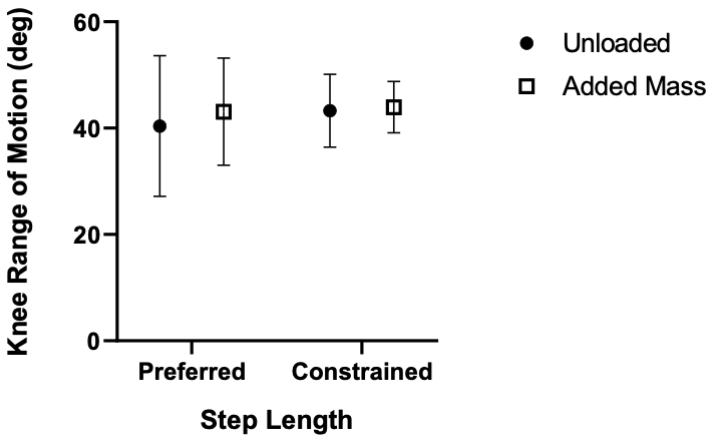

Figure 2. Peak knee range of motion (deg) during level walking with increased mass and constrained step lengths. No changes were observed for added mass (p = 0.57) or constrained step length (p = 0.30).

In Figure 3, no mass by step length interaction was observed for peak knee extension moment (p = 0.306). Further, no main effect of step length (p = 0.153) or mass (p = 0.626) was observed for peak knee extension moment. For peak knee extension power in Figure 4, no mass by step length interaction was observed (p = 0.306). However, a significant main effect of step length was observed (p = 0.037). Post-hoc t-tests revealed that peak knee extension power was greater in the constrained compared to preferred step length conditions for the added mass condition (p = 0.007) but not for the unloaded condition (p = 0.09).

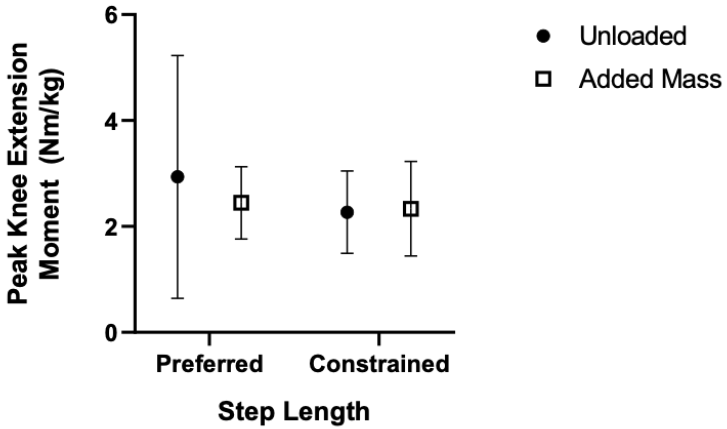

Figure 3. Peak Knee Extension Moment (Nm/kg) during level walking with increased mass and constrained step lengths. No changes were observed for added mass (p = 0.31) or constrained step length (p = 0.15).

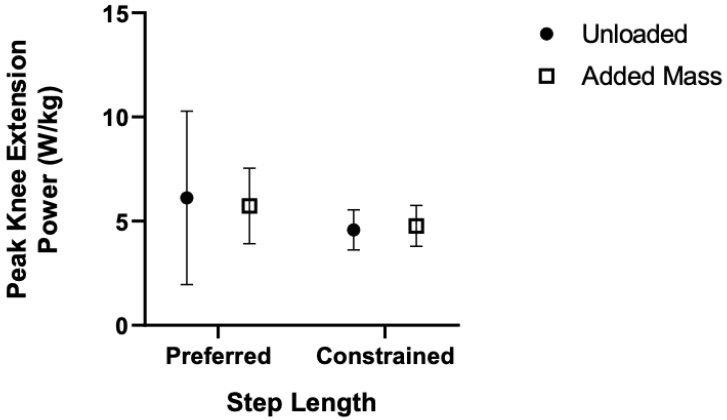

Figure 4. Peak Knee Extension Power (W/kg) during level walking with increased mass and constrained step lengths. Constrained step length was associated with significant increase in peak knee extension power (p = 0.04). No changes were observed for added mass (p = 0.61).

For knee joint reaction forces in Figure 5, no mass by step length interaction was observed (p = 0.753). A main effect of step length was observed (p = 0.019). Post-hoc analyses revealed greater knee joint reaction forces in the preferred compared to constrained step lengths in both unloaded (p = 0.023) and added mass conditions (p = 0.048). No main effect of mass on peak knee joint reaction forces was observed (p = 0.918).

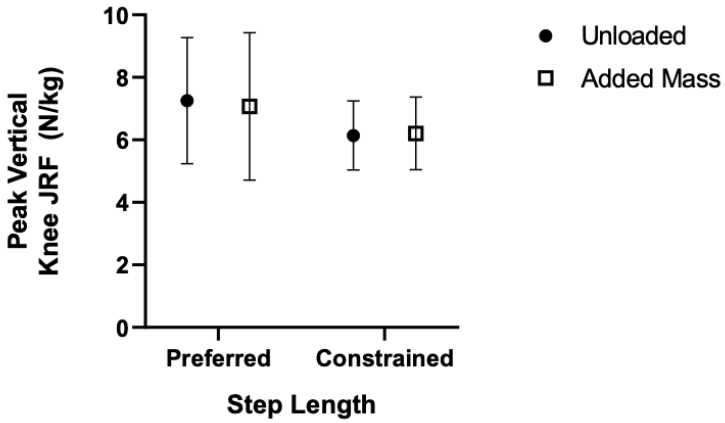

Figure 5. Peak Vertical Joint Reaction Forces (N/kg) during level walking with increased mass and constrained step lengths. Constrained step length was associated with greater knee joint reaction forces (p = 0.02). No changes were observed for added mass (p = 0.75).

Discussion

The purpose of this study was to determine if acutely added mass and/or step length would change knee joint loading during level walking. The major findings of the current study demonstrate that acutely added mass does not alter knee biomechanics; however, constraining step length alters both knee joint kinematics and kinetics. Specifically, constrained step lengths were associated with greater peak knee flexion angles as well as greater joint powers and joint reaction forces.

Current data revealed that acutely added load does not alter knee joint moments and powers during walking. These findings are in contrast with previously published research that demonstrated with added load at the knee during walking, the tasks relative to mass of the individual directly affected joint loads per step and reduced range of motion (Attwells, Birrell, Hooper,

& Mansfield, 2006; Milner et al., 2018). This difference in results can be explained as a chronic versus an acute response, as Messier et al.'s (2005) study was performed in six sessions over an 18-month long weight loss intervention for obese adults. Rather, acute responses to added load have been noted in numerous other studies (Attwells et al., 2006; Knapik, Harman, & Reynolds, 1996). Potential reasons for the differences could be that the added load was not sufficient to create an acute response in recreational athletes. Knapik et al. (1996) started to see significant results at 50% of body weight and up added onto their trained military professionals for kinematic and kinetic differences in walking. This could indicate that a higher stimulus was needed to evoke a difference in our participant population.

However, step length was a strong enough stimulus to evoke a response in knee joint flexion, power, and joint reaction forces. Our findings are supported by Milner et al. (2018), who found that shorter stride lengths reduce knee adduction joint loading. Our results mirror their findings by greater knee joint loads in the preferred step length (i.e., longer step length) compared to the constrained condition. However, our results analyzed different planes of motion compared to Milner et al. (2018) where we analyzed in the sagittal plane (knee flexion) instead of the frontal (knee adduction).

The mechanisms behind the increase in knee joint loading with a longer step length can be defined through kinematic and kinetic variables such as peak knee flexion, extension power, and extension moments. For peak knee flexion, the constrained step length increased under added load compared to the preferred step length condition. Our interpretation is that with an increase in load the subjects adapted to the load by increasing their muscular contribution by flexing the knee, therefore recruiting more muscles to attenuate load. However, this was not represented in the range of motion due to the unaltered state for the constrained added mass condition. This finding is contradicted by Attwells et al. (2006) who found that knee range of motion increases in conjunction to increased load, rather than the knee not changing in range of motion as the load increased. Since range of motion did not change, extension moments at the knee also did not change between conditions, and an increase in flexion was observed. Potentially, our participants walked with their knee more bent, providing a more athletic stance without reaching full extension in between walking phases.

Since there was an increase in peak knee flexion making a more crouched position, an increase of peak knee extension power was potentially due to the increase in force the muscles had to produce while maintaining this flexed position while walking. With the same distance and time the participant had to make a step, the increase in muscle force is a potential source of the increase

in peak knee extension power. While our findings suggest that an increase in muscular contribution to attenuate load helps preserve knee health, past research also states that an increase of load leads to an increase in muscular tension and knee injury (Attwells et al., 2006).

This study has two potential limitations. First, the added mass was applied to the chest region. In obese individuals, accumulative load is seen in alternative areas such as the thigh and lower abdominal regions. This could potentially alter kinematic variables in walking. As shown by Westlake et al. (2013), an increase in thigh circumference alters walking kinematics. If the load was distributed in other regions, such as the thigh, with altered kinematics, we could potentially alter walking kinetics. Another limitation could be that all of our subjects were athletes and not obese individuals. This could affect results since the participants were recreationally active and have an increased ability to adapt to stress unlike the population that this study simulated, obese adults. This was seen by Knapik et al. (1996) who found that foot soldiers did not have altered walking biomechanics until over fifty percent of their body weight was added to their weighted vest. Future studies should look at added load in alternate locations and with different populations to note if a simulated state shows accurate similarity between the two.

The current data demonstrate that increased step length (preferred step length condition) compared to the average preferred obese individuals' step lengthwith or without added mass, decreases the load on the knee. Our findings add to past research that find an increase in stride length could help decrease the risk to skeletal structures by increasing the contributions to muscular components. This information can be applied clinically to individuals with a high risk of OA, such as older and obese populations, to make conscious decisions to increase stride length. However, more studies are needed to investigate simulated obese states to ensure a correlation between 'obese' and 'simulated' investigation data collection structures.

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