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PARENTHOOD AND ITS EFFECTS ON PERFORMANCE IN ACTIVE DUTY MEDICAL PERSONNEL

by

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13. ABSTRACT (maximum 200 words)

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PARENTHOOD AND ITS EFFECTS ON PERFORMANCE IN ACTIVE DUTY MEDICAL PERSONNEL

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Minimal research to date has examined the impact of new parenthood on either military personnel or medical professionals. This thesis aims to identify the specific impacts of new parenthood on performance of military medical professionals, a group of highly skilled, in-demand, and costly-to-train servicemembers. Using quarterly data from 2013–2019 obtained from the Army Person Data Environment, we used individual fixed effects models to identify how new parenthood impacts physical performance of Army and Navy medical enlisted and officers, using physical fitness test scores and body mass index. Models were controlled for age and analyzed by gender and officer/enlisted status. Results indicate that parenthood has significant negative effects on new parent physical fitness for military medical personnel. Detrimental effects to fitness persisted longest for female officers. Negative effects were greater in female personnel than male personnel, and greatest in female officers. These results indicate a need to adopt policies that promote a culture of fitness that coincides with parenthood, including, but not limited to, universal adoption of physical training during work hours, resources directed toward physical training in the pregnancy and postpartum periods, safe physical training while under other life stressors, such as sleep deprivation, and general lifestyle health behaviors. Modifying the timeline of postpartum return to physical fitness testing may also be warranted.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACT-FAM	Active Duty Family
ADE	Navy Authoritative Data Environment
ACT-MAST	Active Duty Military Personnel Master
ADSM	Active Duty Service Member
APFT	Army Physical Fitness Test
APRN	Advanced Practice Registered Nurse
ASVAB	Armed Services Vocational Aptitude Battery
BMI	Body Mass Index
BSN	Bachelor of Science in Nursing
CRNA	Certified Registered Nurse Anesthetist
DDS	Doctor of Dental Surgery
DEERS	Defense Enrollment Eligibility Reporting System
DMD	Doctor of Medicine in Dentistry
DO	Doctor of Osteopathy
DOD	Department of Defense
DTMS	Digital Training Management System
FITREP	Fitness Report
HADR	Humanitarian Assistance/Disaster Relief
HQDA	Headquarters, Department of the Army
MD	Medical Doctor
MEPS	Military Entrance Processing Site
MOS	Military Occupational Specialty
MSC	Medical Service Corps
MTF	Military/Medical Treatment Facility
MVPA	Moderate to Vigorous Physical Activity
NOB	Non-Observed
PDE	Person-Event Data Environment
PFA	Physical Fitness Assessment
PRIMS	Physical Readiness Information Management System
PRT	Physical Readiness Test

TAP-DB	Total Army Personnel Database
TIG	Time in Grade
TIS	Time in Service
USMC	United States Marine Corps

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I. INTRODUCTION

Both military and medical careers are known to require significant commitments for performance and longevity. Moreover, both careers demand extraordinary time, energy, and physical capabilities when the majority of Americans are planning families, having children, and attempting to balance family with career demands (Harris, 2009).

Men and women both cite parenthood and family concerns as two major reasons for leaving the military (Defense Advisory Committee on Women in the Service, 2004). Military mothers, especially, face disproportionate issues in obtaining childcare and balancing careers with family obligations (DiSilverio, 2003; Keller et al., 2018; Kelley et al., 2001; King et al., 2019, 2020; Pierce, 1998). Furthermore, military women have lower retention rates and smaller promotion chances than men (Asch et al., 2012).

Parenthood creates issues with retention and performance among medical professionals as well, as physicians with significant childcare obligations have lower employment rates, worse career outcomes, and a higher desire to work part-time or to change careers (Buddeberg-Fischer et al., 2010; Lyu et al., 2019).

Military service also requires physical capabilities and body composition standards, generally referred to as physical readiness. These standards are considered the minimum requirements to ensure an ability to achieve a broad spectrum of missions that may demand anything from seated office work to field exercises to active combat. Medical professionals routinely deal with job demands that require both physical endurance and strength, in the form of long periods of standing, crouching, or leaning, as well as the necessity to move or assist patients from one position to another. Military medicine can encompass the entire spectrum of the physical demands of both military and medical occupations, although direct involvement in combat is rare.

Just as members of military medicine face stressors their health and well-being, new parents face significant strains on physical capability and mental acuity. Fathers and mothers suffer from significant sleep disturbances, a wide range of undulating emotions, and a lack of time for physical fitness pursuits (Bellows-Riecken & Rhodes, 2008; Gay et al., 2004; Genesoni & Tallandini, 2009; Pot & Keizer, 2016; Saxbe et al., 2018). Meanwhile, new mothers are in recovery from the physical and emotional toll of pregnancy, labor, and delivery, encompassing numerous psychological and physiological changes (Buckley, 2015; Saxbe et al., 2018; Winberg, 2005).

While existing literature has documented negative effects of parenthood on retention, physical readiness and performance for military personnel and medical professionals separately, we know less about the effects of parenthood on military medical service personnel, especially new mothers. Considering the substantial resources Department of Defense (DOD) invests in attracting, recruiting, and fully training medical professionals within the military, understanding how parenthood impacts physical readiness, job performance and retention among all levels of medical personnel can provide significant value from a policy and cost-benefit perspective.

To study the effects of parenthood on military medical personnel, we analyzed quarterly personnel data on Army and Navy active duty personnel from 2013–2019. We focused on medical professionals in the officer and enlisted communities.

We used an individual fixed-effects framework comparing scores on Army Physical Fitness Tests (APFT), Navy Physical Readiness Test (PRT), and Navy body mass index (BMI) measurements for the same individual before and after the birth of their first child that was born between 2013 and 2019. We compared these first-time parents to a reference group of childless individuals during the period of study.

We find Army male enlisted personnel APFT scores decreased in the cycle immediately prior to birth and through two cycles post-birth of their first child. Female enlisted personnel APFT scores also decreased from post-birth through four cycles after birth. Male officers show a significant decrease in APFT score in only the cycle at birth of the first child. Female officers show a significant decrease in APFT score from post-birth through six cycles.

Navy male enlisted personnel PRT scores showed a significant decrease in the Physical Fitness Assessment (PFA) cycles immediately prior to birth of an individual's first child through one cycle post-birth. Female enlisted personnel show a significant decrease in their PRT scores through three PFA cycles post-birth. Male officers show no significant decrease in their PRT scores relative to birth. Female officers show a significant decrease through three PFA cycles post-birth.

Our analysis of Navy Medicine personnel's BMI showed that the only subgroup to have significant changes in BMI relative to baseline were male enlisted. This population showed a significant decrease in their BMI beginning one PFA cycle after birth. All other subgroups showed declines in BMI, but these changes were neither statistically nor clinically significant compared to baseline measures.

Our findings show that parenthood has significant and measurable effects on the physical health and performance of Army and Navy medical personnel. Understanding these effects will help leadership better design and implement policies to positively promote parenthood, physical fitness, and performance in the Department of Defense.

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II. BACKGROUND

In July 2015, then-Secretary of the Navy, Ray Mabus, announced a Department-wide change in both the maternity and paternity leave policies of the U.S. Navy. This policy expanded paternity leave for male Marines and sailors from 10 to 14 days of uncharged leave. For females, the change was even greater, as the maternity leave period expanded from 6 to 18 weeks (Office of the Secretary of the Navy, 2015). Shortly after this change to Navy policy, the Secretary of Defense then directed the services to adopt the standardized maternity leave period at 12 weeks for all services (Ferdinando, 2016). This change moved DOD maternity and paternity policies to align with the trends in highly skilled civilian industries that have seen additional parental leave granted to their workforces. It should be noted, however, that unpaid parental leave is still more common than paid parental leave within the U.S. civilian sector. A change of this magnitude seemed unprecedented for such a large organization like the DOD. However, it highlighted what has become a shift toward more progressive policies and rhetoric aimed toward military families, gender diversity, and overall inclusiveness.

Army Medicine provides uniformed medical personnel to support Army combat and non-combat operations. Personnel are assigned to medical treatment facilities (MTFs) or embedded within combat units. Navy Medicine provides uniformed medical personnel to support the Navy and Marine Corps.

Military medicine has changed over the past decades as it attempts to balance training and readiness of military forces with the training and readiness of medical personnel. Changes to military medicine consistently focus on husbanding national resources through efficient asset utilization, with greater synchronization of affected personnel to drive reform and innovation. The Department of Defense utilizes in-garrison hospitals, medical centers, and clinics to train and prepare personnel for deployments to conflict zones, field exercises, and humanitarian assistance/disaster relief (HADR) operations. Medical personnel are also embedded within operational units to provide regular readiness, primary care, and/or emergency care.

The dual mission of military medicine requires a balance between providing care to in-garrison beneficiaries and active duty service members while preparing for military operations. Operational requirements often encompass skills divergent from day-to-day medical care needed in the shore establishment. This requires a delicate balance between recruiting, training, and retaining an appropriate skill mix of medical personnel to simultaneously meet these missions.

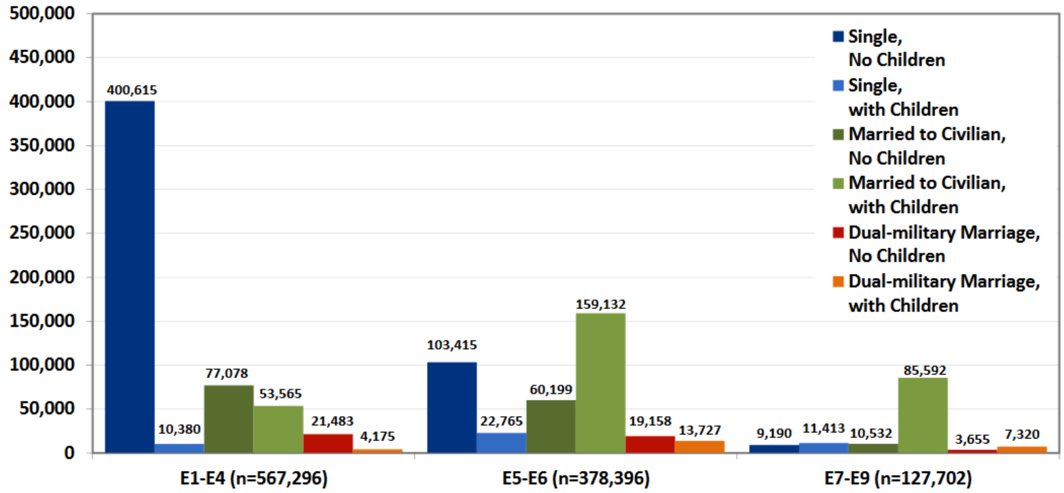
Military medicine uses a workforce of officers and enlisted personnel. Enlisted personnel carry out a variety of administrative and clinical tasks, from patient check-in and medical records management to specialized technical work such as x-ray or laboratory technician. Analogous to the civilian sector, these positions typically require at least a high school diploma and, in some cases, a two year degree or certificate. Initial entry into the enlisted medical community is most frequently conducted when a potential recruit goes through the screening process at a Military Entry Processing Site (MEPS). The recruit selects their future military occupational specialty (MOS), or rating based on its availability and the recruit's score on the Armed Services Vocational Aptitude Battery (ASVAB). Each service sends its enlisted medical personnel to a combined Medical Enlisted Training Command in San Antonio, Texas. Follow-on training is provided at service schools for medical personnel selected for more specialized roles and are typically based on a competitive selection process.

The military medical officer community consists of five Corps: Medical Corps, Nurse Corps, Medical Service Corps, Dental Corps, and Veterinary Corps. Each encompasses a distinct area of medical expertise, and requirements for commission in each depending on meeting specific educational and/or experiential requirements. The Medical Corps (MC) consists of physicians, requiring at a minimum a Medical Doctorate (MD) or Doctor of Osteopathic Medicine (DO) degree from an accredited institution, and obtaining a medical license after completing postgraduate year one training. The Medical Corps includes primary care providers, surgical specialists, and non-surgical specialists. The Nurse Corps (NC) consists of a range of nursing careers with a minimum requirement of a Bachelor of Nursing (BSN) from an accredited institution, and a Registered Nurse (RN) license. The Nurse Corps includes advanced practice nurses such as Advanced Practice

Registered Nurses (APRNs), Certified Registered Nurse Anesthetists (CRNAs), and Nurse Practitioners in addition to general nursing. The Medical Service Corps (MSC) consists of more than two dozen subspecialties, including administrators, scientists, and clinicians, covering fields as diverse as pharmacy to healthcare administration and biochemistry. Each subspecialty has a distinct requirement for educational and/or experiential requirements related to their professional field. The Dental Corps (DC) consists of dentists, with a requirement for a Doctorate of Dental Surgery (DDS) or Doctorate of Medical Dentistry (DMD) from an accredited institution, and includes specialists, such as endodontists, and oral surgeons as well as general dentists. The Veterinary Corps is unique to the Army and specifically focuses on food and health safety as well as care for military working dogs and ceremonial horses. The veterinarians are supported by Food Inspection Warrant Officers and enlisted personnel.

The military pay and benefits structure is such that service members are incentivized to marry and bear children at younger ages than they might otherwise. These benefits are both cash and in-kind in nature, from higher housing allowance for those with dependents, to greater value from the health benefit, commissary privileges, and morale activities provided by the services (Hogan & Furst Seifert, 2010; Koball et al., 2010). The structure of military pay and benefits provides a strong safety net for personnel. Policies and programs are of a depth and breadth that support service members' decisions to marry rather than stay single during their careers (Lundquist & Xu, 2014). As an all-volunteer force is more likely to include career-oriented members who serve beyond one enlistment or service obligation (as compared to conscription-based military service members), active duty service members are more likely to have a child at some point while they are serving than the conscription-based model of the past.

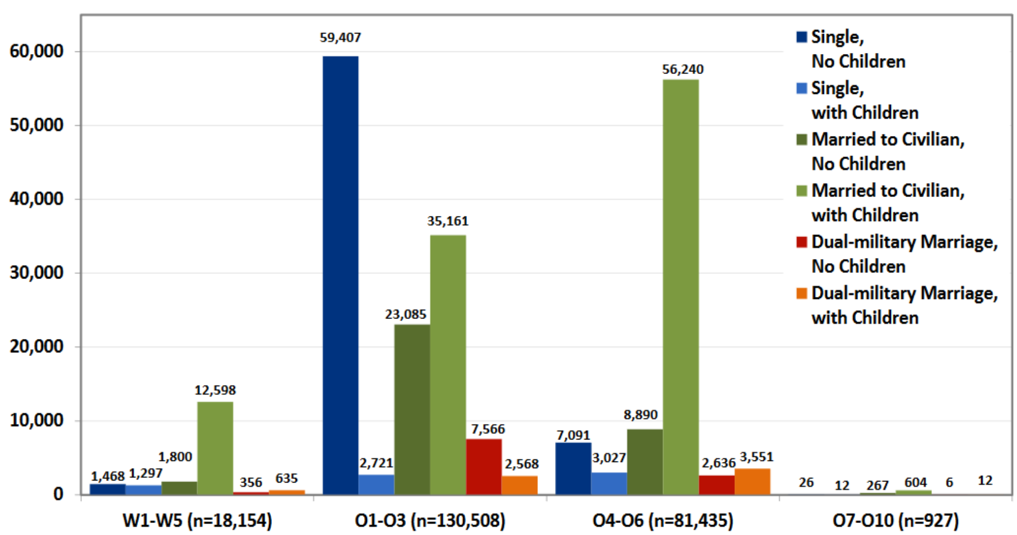
In 2018, the Department of Defense Assistant Secretary of Defense for Military Community and Family Policy annual study found that 37.3% of active duty service members had children, each service member parent having on average two children. In 2018, 33,568 active duty service members had their first child. For both officer and enlisted members, personnel in higher pay grades are more likely to be married to a civilian and have children. On average, service members see their first child's birth occur at 25.8 years of age (Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018).



Note: Single includes annulled, divorced, and widowed. Children include minor dependents age 20 or younger and dependents age 22 or younger enrolled as full-time students.

Source: Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018.

Figure 1. Active Duty Enlisted Member Family Status by Paygrade



Note: Single includes annulled, divorced, and widowed. Children include minor dependents age 20 or younger and dependents age 22 or younger enrolled as full-time students.

Source: Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018.

Figure 2. Active Duty Officer Family Status by Paygrade.

In general, the majority of new accessions to the military are single and childless, and often acquire spouses and child(ren) in their first term of enlistment or obligated service (for officers) (Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018). Typically, enlisted personnel enter the service at younger ages than officers due to the educational requirements for commission. Enlisted members also have children at younger ages than their officer counterparts, mirroring a trend in the general population of the United States, where more highly educated individuals tend to delay parenthood (Brand & Davis, 2011).

Military personnel are frequent subjects of research by internal and external organizations, and military family policy is a frequent hot-button political issue and concern. Recent efforts to increase female participation in the military have led to increased efforts to understand the unique challenges present for female service members compared to their male counterparts. Historical policies that were mainly targeted toward civilian spouses of male service members may not be appropriate or sufficient to serve the needs of female service members seeking to access necessary support during their transition to parenthood.

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III. LITERATURE REVIEW

In this chapter, we review the literature on parenthood, family leave policy, health of military service members and medical professionals, military family culture and labor force participation effects of parenthood. New parenthood takes a toll on the physical and psychological health of the parents and may influence health behaviors for years to come. This has direct implications for the health and effectiveness of both healthcare professionals and military service members. Parenthood, especially motherhood, has been shown to dramatically affect labor force participation and productivity.

A. FAMILY LEAVE POLICY

Most of the literature finds/suggests parental leave policies across space and time improve maternal and child health outcomes. For example, recent studies on the effects of Norway's paid maternity leave and Sweden's paternity leave policy found improvements in women's health outcomes. Norway's introduction of paid leave for mothers in 1977 improved a mothers' overall health by reducing both mental and physical pain while increasing their likelihood to exercise and minimize smoking (Butikofer et al., 2018). In Sweden, when fathers were granted the ability to take paternity leave along with a mother's maternity leave, women's health improved (Persson & Rossin-Slater, 2019). In this study, mothers were less likely to visit a doctor about post-birth complications or seek any over the counter medications, which suggests that women received additional benefits from the improvement of their physical and mental health because of this policy.

Another study on general surgery and surgical subspecialists in the United States found that barriers to parenthood include a combination of unclear or nonstandard policies, lack of program flexibility, as well as the perception that having a child will cause a strain on their coworkers and detract from the workplace (Altieri et al., 2019). This is similar to military culture where mission comes before individual preferences and having children is a distraction from the workplace and causes a strain on those individuals who are left to carry out the assigned duties while the pregnant or postpartum member is unavailable for their typical duties.

B. HEALTH EFFECTS OF PARENTHOOD

Newborns add a significant toll on first-time and other parents both physiologically and psychologically. Disruptions to sleep, increased demands of time and attention, and heightened inflammatory markers are the norm, vice the exception (Denney et al., 2011; Hagen et al., 2013; Saxbe et al., 2018). At this time, mothers are in recovery from the physical trauma of childbirth and adjusting to potentially dramatic fluctuations to hormonal biology as they transition from childbearing to infant care (Buckley, 2015; Winberg, 2005). Both parents throughout the pregnancy and into new parenthood also face multiple psychological challenges in adding the role of caregiver (Genesoni & Tallandini, 2009; Reid & Taylor, 2015; Saxbe et al., 2018). These include sleep disruption, decreased physical activity, depression, and allostatic load. These problems can be exacerbated for parents who lack paid time off from their employer to recover and adjust to their new life situation.

Critically, birth may represent an inflection point for future cardiovascular health, body composition, and physical ability, as parents report lower physical activity levels than non-parents (Saxbe et al., 2018). While one commentary suggests that men report proactively improving a number of health behaviors (Garfield et al., 2006) as new fathers, other literature notes decreased time spent on physical activity by mothers and fathers. In particular, mothers tend to participate in less activity than fathers, and mothers and fathers of young children spend the least time in moderate to vigorous physical activities (Bellows-Riecken & Rhodes, 2008; Pot & Keizer, 2016). Even a study in female golfers revealed that professional athletes who become mothers seem to suffer in physical performance relative to non-mothers (Kalist, 2008).

Despite the impediments to time and energy to engage in physical activities and other self-care that are placed upon parents, the Army and Navy expect their members to uphold their physical fitness and body composition, regardless of age or parental status. In the Navy, studies suggest a return to physical standards is a fairly common struggle for mothers (Greer et al., 2012). In the Marine Corps, mothers have reported negative effects from the pressure of previous policies to pass the fitness standards in less than six months after childbirth (Baker, 2015). These surveys led to the study of the effects of parenthood on the physical fitness effects on new Marine Corps parents, with results showing there are negative effects on physical performance test scores on both mothers and fathers in the time periods leading up to, and after, childbirth (Cordero, 2020; Healy & Heissel, 2020; Larson, 2020). The findings for this small and unique population are interesting and relevant and point to the need for additional research into the actual physical effects that parenthood has on the performance of new parents.

C. PHYSICAL HEALTH OF HEALTHCARE WORKERS

Healthcare workers as a whole are a population at increased risk of physical inactivity, poor health habits, and numerous acute and chronic medical issues, including injuries, type 2 diabetes, and coronary artery disease (Helfand & Mukamal, 2013; Holtzclaw et al., 2020; Mohanty et al., 2019; Romito et al., 2020; Stanulewicz et al., 2019). This may seem counterintuitive, but the long hours, irregular schedules, and emotional toll of their work all result in a challenge to maintain physical and mental health. Those workers who work the most hours are also those most at risk of higher BMI as well as leaving their occupation (Holtzclaw et al., 2020; Kramer & Son, 2016; Mohanty et al., 2019). These results are not consistent across all groups within the continuum of healthcare workers, which ranges from clerical and administrative staff, to physicians, dentists, allied health professionals, and nurses. These different occupational groups have distinct and varied work environments, from regular office hours to rotating shift work. Subsequent research highlighted below shows more targeted analysis and differences based on occupation and work environment of these differential effects.

Differences in health behaviors seem to be related to education, with those with at least an undergraduate college education tending to engage in more health promoting behaviors, such as exercise and maintenance of normal body weight (Chiou et al., 2014; Helfand & Mukamal, 2013). While some evidence suggests physicians are more active and less likely to be overweight or obese than the normal population or even compared to other healthcare professionals (Chiou et al., 2014; Stanford et al., 2012), other studies suggest healthcare professionals have a surprisingly poor knowledge of standard diet and exercise guidelines recommended by the American Heart Association (Aggarwal et al., 2020).

Notably, physical fitness among prospective physicians has been linked to better performance and may act as a predictor of effectiveness in the field long term (Stephens et al., 2015).

Additional evidence links certain types of work within healthcare professions to poorer health outcomes than others. Nurses, especially those working long hours, seem to be at disproportionate risk for low physical activity and overweight/obesity (Stanulewicz et al., 2019). Among health professions, evidence suggests nurses have the least physical activity, fruit and vegetable consumption, and worst adjustment to stress (Chiou et al., 2014). Studies of nurses and nursing students reveal very poor adherence to public health recommendations, at rates less than half across guidelines for physical activity, fruit and vegetable consumption, and high fat and sugar food consumption (Hawker, 2012; Malik et al., 2011). These relatively small (n=215 and =876), cross-sectional studies relied on self-reported measures of healthy behaviors. With the known bias toward the halo effect in self-reported surveys, these results may indicate even larger issues with proper healthy behavior in the nursing field.

Despite their position of knowledge on health behaviors, health care workers routinely do not practice these “good” health behaviors. Foregoing health behaviors, strenuous work situations, and long hours may all play an important role in long term risks to healthcare worker health and performance. The strain of new parenthood is likely only to exacerbate these issues among healthcare professionals.

Although the fields seem largely divergent, military service members show some similar issues regarding physical health. Although military service members, like healthcare professionals, are in better physical health than the civilian population, there are key lifestyle issues increasing risk to physical health.

D. PHYSICAL HEALTH OF MILITARY SERVICE MEMBERS

Research on the overall health of active duty service members has shown differential results depending on gender. Compared with civilian men, active duty men report relatively good health and access to health care services, but increased participation in unhealthy lifestyles such as smoking and excessive alcohol consumption (Hoerster et al., 2012; Lehavot et al., 2012). Active duty women self-report that they have less engagement in unhealthy lifestyle behaviors, better access to health care, and are in better physical health as compared to civilian women (Hoerster et al., 2012; Lehavot et al., 2012). A study of military and civilian hospital employees on predictors of healthy behaviors found that the hierarchical structure, social support, and mandatory requirements such as the Army Physical Fitness Test had a positive effect on active duty members engaging in healthy behaviors while highlighting the importance of leadership engagement in their subordinates' health (Wynd & Ryan-Wenger, 2004).

E. MILITARY FAMILY CULTURE

Parental support policies play a major role in decisions of service members to remain in the military or attrite to the civilian economy (Department of Defense, 2010; Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018; Hogan & Furst Seifert, 2010). Multiple studies on retention of junior and mid-grade officers across service branches have all shown that the challenges of parenthood are significant drivers of female officers' decisions to remain in the service or not. Availability of child-care on base, family-friendliness of supervisors, and dual-military status are all key factors in these decisions (Bandy, 2019; Huffman et al., 2016; King et al., 2019).

Addressing the aforementioned barriers to attracting and retaining qualified women in the United States military is critical, as women make up nearly 50% of the eligible recruitable population in the country, yet currently are less than 17% of the active duty military workforce (Bureau, n.d.; Department of Defense, Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy, 2018). Significant resources are expended to attract and retain women, yet there have been limited results of these efforts in increasing substantially the proportion of women in the military (King et al., 2019). Research by Farrell (2020) shows that parents in all branches make different career choices depending on their family status as compared to service members who are not parents. These differential behaviors are affected by marital status and gender as well. (Farrell, 2020).

F. LABOR FORCE PARTICIPATION, PRODUCTIVITY, WAGES, AND OTHER ECONOMIC OUTCOMES

Military service entails long-term contracts and service obligations, with no opportunity for part-time work. This results in individuals being forced to make decisions at set points in their career on whether to remain in service for another three to four years, or attrite to the civilian economy. This typically occurs when an enlistment contract is expiring for enlisted members, or an active duty service obligation is expiring for officers.

There is much literature on the effects of motherhood of labor force participation in the civilian sector. Overall, motherhood is associated across time and career field to have significant effects on women's labor force participation, productivity, desire for full or part time work, earnings, and type of profession chosen. In general, women do not anticipate the effects of motherhood on views toward employment and after becoming mothers, they tend to view female employment more negatively. Women report parenthood to be harder than anticipated, and female high school seniors significantly overestimate the likelihood they will be in the labor market in their 30s (Kuziemko et al., 2018).

Research by Juhn and McCue (2017) on the evolution of the gender gap associated with marriage and parental status looked at cohorts born between 1936 and 1985 and utilized data from the Current Population Survey from 1962–2015. Their research found that married women in later cohorts behave similarly to men when it comes to earnings, and have a slight advantage compared to single women. Married women are less likely to reduce quantity of work. Married women in households with minor children were shown to have substantially lower earnings. The specialization by gender in married households has continued over time according to Juhn and McCue (2017), and is especially pronounced for those women in high-paying career fields compared to their male counterparts. The earnings of women seem to plateau in the period after they have children. High-skill women tend to switch to more part-time work, while low-skill women are more likely to withdraw from the labor force altogether. Juhn and McCue found that women in high-skill fields tend to have children while married in peak earning years, compared to women in low-skill fields who have children at younger ages and are currently earning relatively little money. These findings are consistent with the population studied in this thesis, as enlisted personnel (typically lower skill) tend to have children in their early 20s, while officer personnel in the medical professions tend to have children in their late 20s to early 30s (Wilde et al., 2010). There is a concern of severe selection bias in the professional and family decisions made by those in this study. Similar selection bias is found with the population of individuals who choose to enter, and then remain in, the military as discussed above.

Parenthood affects productivity and performance of professionals, but this varies by gender and marital status (Krapf et al., 2017; McIntosh et al., 2012). Performance of academic economists was not significantly impacted by a first child, but mothers of two or more children and unmarried mothers had worse performance (Krapf et al., 2017). Moreover, becoming a mother at less than thirty years old was linked to negative impacts on research productivity. Conversely, untenured men showed greater productivity regardless of marital or parenthood status (Krapf et al., 2017). These findings are similar to research by McIntosh et al. (2012) on Scottish nurses in the National Health System. They found that women with children prior to school age, and those who took more than two years off from work showed detrimental effects on career progression, while men showed positive effects of parenthood.

Multiple studies have been conducted on physicians and parenthood. These studies have found that there are differences by gender, specialty, and marital status for physicians in the civilian economy. Mothers have more domestic responsibility than their partners according to this research, with proceduralist mothers reporting being more dissatisfied the more domestic responsibilities they hold compared to their spouse. These findings show that the only group to be affected negatively regarding pay were married mothers. Single men, women, and married men all were unaffected in this manner. Furthermore, women were shown to be consistently under-represented in leadership roles, report challenges to career progression, and have less propensity to work full-time as compared to men. (Grant et al., 1990; Lyu et al., 2019; Reed & Buddeberg-Fischer, 2001)

The rigid military personnel structure, embedded culture, and overwhelmingly male dominated leadership of the Department of Defense and the individual services all represent barriers to improved retention and performance of female personnel in the military. Studying the effects of parenthood and identifying policy changes to incorporate outside research and successes within the bounds of military reality is critical to improving these retention and performance outcomes of service women.

To this point there has been no systematic analysis of the performance effects that new parenthood has on either medical professionals or military personnel. The military population provides a unique opportunity to identify these specific trends due to the in-depth nature of military requirements, record keeping, and large quantities of individuals on whom this data is collected and stored. Recent initiatives to increase the number of women in the military, policy changes that increase parental benefits, and financial pressures to reduce the overall cost of military personnel and healthcare expenditures all point to the value of studying the effects that parenthood has on the military medical workforce.

IV. DATA AND METHODOLOGY

In this chapter, we first describe the data we use to study active duty Army and Navy medical personnel. We then discuss our empirical methodology to identify the variables and outcomes of interest within these populations. A brief overview of some data limitations and the assumptions we made to code our analysis. Finally, we describe how we analyzed the effects of parenthood on physical fitness scores and standards.

We used panel data on 51,536 Army personnel and 52,079 Navy personnel to analyze fitness and performance changes before and after the birth of the first child for active duty Army and Navy medical personnel. The military personnel databases we extracted data from include Defense Eligibility Enrollment Reporting System (DEERS), Navy Training Management and Planning System (NTMPS), Total Army Personnel Database-Enlisted (TAPDB), Army Digital Training Management System (DTMS), Navy Authoritative Data Environment (ADE), Active Duty Military Personnel Master (ACT-MAST), Active Duty Family (ACT-FAM), and the Navy Physical Readiness Information Management System (PRIMS). All were accessed through the Army's Person-Event Data Environment (PDE) system in the period August 2020 through March 2021. These data were used to create Figures 3–8 and Tables 1–5 in this thesis.

Our dataset includes quarterly observations for active duty Army and Navy personnel from March 2013 through September 2019. The data include basic demographic information such as age, gender, rank, and marital status. Dependent data for spouses and children includes date of birth, number of dependents per servicemember, and dependent type (spouse, child, or other). Each observation within this study represents a quarterly snapshot of a given individual servicemember's demographics, performance, and dependent information.

Only medical community personnel were used for the purpose of our research. We used service member occupation codes and/or designator codes to identify servicemembers with codes matching those known to be associated with enlisted medical personnel (Army medic, Navy hospital corpsman), and officers of the Medical Corps, Dental Corps, Medical Service Corps, Nurse Corps, and Veterinary Corps.

Additionally, we limited our analysis to only those medical personnel who had their first child during this observation window (March 2013–September 2019). Personnel were considered childless if they had not yet had their first child. We excluded personnel who previously had one or more children prior to the observation window. This comparison across childless personnel and personnel having their first child provides the most direct insights into the impacts of the change from non-parenthood to new parenthood. We used a fixed effects model to compare the change in scores for the same individuals before and after they had their first child, relative to changes in those individuals who did not have a child in this study window.

A. SUMMARY STATISTICS

Table 1 reports the summary statistics for the Army personnel used in our analysis. Table 2 reports the summary statistics for the Navy personnel used in our analysis. Both tables compare the new parents to the non-parents (referred to here as controls).

Table 1. Summary Statistics for Army Medical Personnel March 2013–September 2019

	Control Male Enlisted	New Parent Male Enlisted	Control Female Enlisted	New Parent Female Enlisted	Control Male Officer	New Parent Male Officer	Control Female Officer	New Parent Female Officer
APFT Score Total	243.88 (37.33)	243.94 (34.94)	248.66 (37.96)	243.42*** (37.94)	255.63 (36.39)	247.88*** (35.72)	260.37 (35.17)	256.57*** (36.35)
BMI (kg/m^2)								
Age (years)	28.20 (8.06)	25.96*** (4.72)	28.06 (7.67)	25.42*** (4.68)	39.46 (9.01)	31.81*** (4.48)	36.45 (9.37)	31.22*** (4.89)
Married (0/1)	0.45 (0.50)	0.72*** (0.45)	0.44 (0.50)	0.59*** (0.49)	0.72 (0.45)	0.83*** (0.38)	0.50 (0.50)	0.78*** (0.41)
Time in Grade (years)	1.91 (2.17)	1.47*** (1.45)	1.90 (2.12)	1.57*** (1.55)	3.23 (2.49)	2.53*** (1.82)	2.83 (2.25)	2.48*** (1.81)
White (0/1)	0.70 (0.46)	0.71*** (0.45)	0.58 (0.49)	0.55*** (0.50)	0.80 (0.40)	0.83*** (0.38)	0.69 (046)	0.76*** (0.43)
AFQT Percentile	72.30 (16.75)	72.70*** (15.87)	67.41 (16.85)	66.89*** (16.10)				
Observations	87,021		28,621		33,481		20,173	
Individuals	24,229		8,566		7,853		5,076	

Standard deviation noted in parentheses.

*Significant differences between control and new parent group at $p<0.05$

**Significant differences between control and new parent group at $p<0.01$

***Significant differences between control and new parent group at $p<0.001$

Data retrieved from PDE system, August 2020-March 2021.

New parents in the Army population had lower average APFT scores compared to controls for female enlisted, male officers, and female officers. These differences are significant at $p<0.001$ for female enlisted (248.66 compared to 243.22), male officers (255.63 compared to 247.88), and female officers (260.37 compared to 256.57).

BMI was unable to be properly analyzed for Army personnel.

New parents were younger compared to the controls for all four subgroups: male enlisted (25.96 compared to 28.20), female enlisted (25.42 compared to 28.06), male officer (31.81 compared to 39.46), and female officer (31.22 compared to 36.45). These results are significant at $p<0.001$ for all subgroups.

New parents were more likely to be married than the controls for all four subgroups, with significance at $p<0.001$. Male enlisted (0.72 compared to 0.45), female enlisted (0.59 compared to 0.44), male officer (0.83 compared to 0.72), and female officer (0.78 compared to 0.50).

In all subgroups, new parents had 0.4-1.4 fewer years' Time in Grade (TIG) compared to the controls. Male enlisted new parents averaged 1.47 years TIG compared to 1.91 in the control group. Female enlisted new parents averaged 1.57 years TIG compared to 1.90 in the control group. Male officer new parents averaged 2.53 years TIG compared to 3.23 in the control group. Female officers average 2.48 years TIG compared to 2.83 in the control group. These findings were significant for all groups at $p<0.001$.

New parents were more likely to be white than the control group for all subgroups except female enlisted. Male enlisted (0.70 compared to 0.71), male officer (0.83 compared to 0.80), and female officer (0.76 compared to 0.69). Female enlisted personnel in the new parent group were less likely to be white than the control, 0.55 compared to 0.58. These findings are significant at $p<0.001$ for all subgroups.

Finally, new parents have average AFQT percentiles that are either higher or lower than the control group, depending on gender. Male enlisted new parents have lower average AFQT percentiles (72.70 compared to 72.30) than the control group, and this is significant at $p<0.001$. Female enlisted new parents average a lower AFQT percentile (66.89 compared to 67.41) than the control group, and this is also significant at $p<0. 001$.

These scores are only recorded for enlisted personnel, as officers have no similar test score requirement for service.

Table 2. Summary Statistics for Navy Medical Personnel March 2013–September 2019

	Control Male Enlisted	New Parent Male Enlisted	Control Female Enlisted	New Parent Female Enlisted	Control Male Officer	New Parent Male Officer	Control Female Officer	New Parent Female Officer
PRT Score Total	217.17 (39.21)	209.69*** (39.21)	214.86 (38.88)	203.05*** (40.28)	227.34 (39.00)	226.87 (38.33)	230.51 (38.74)	232.01* (39.05)
BMI (kg/m^2)	26.95 (3.54)	26.68*** (3.58)	25.39 (3.42)	25.15*** (3.55)	26.50 (3.00)	25.78*** (2.82)	24.12 (3.06)	23.52*** (2.77)
Age (years)	27.96 (6.60)	24.66*** (4.00)	27.23 (6.58)	23.62*** (3.87)	40.08 (8.09)	31.69*** (4.11)	36.47 (8.37)	30.02*** (4.43)
Married (0/1)	0.52 (0.50)	0.73*** (0.44)	0.44 (0.50)	0.62*** (0.49)	0.81 (0.39)	0.90*** (0.30)	0.57 (0.50)	0.75*** (0.43)
Time in Grade (years)	2.49 (1.95)	1.70*** (1.33)	2.32 (1.95)	1.57*** (1.32)	3.45 (2.67)	2.02*** (1.59)	2.84 (2.28)	1.85*** (1.56)
White (0/1)	0.55 (.50)	0.58*** (0.49)	0.51 (0.50)	0.54*** (0.50)	0.80 (0.40)	0.83*** (0.37)	0.73 (0.44)	0.78*** (0.42)
AFQT Percentile	66.17 (16.15)	68.69*** (14.35)	62.82 (14.43)	64.91*** (12.55)				
Observations	189,103			47,719		60,117		31,164
Individuals	29,592			9,106		7,981		5,040

Standard deviation noted in parentheses.

*Significant differences between control and new parent group at p<0.05

**Significant differences between control and new parent group at p<0.01

***Significant differences between control and new parent group at p<0.001

Data retrieved from PDE system, August 2020-March 2021.

New parents in the Navy population had lower average PRT scores compared to controls in all subgroups except for female officers. For male enlisted (209.69 compared to 217.17) and female enlisted (203.05 compared to 214.86) new parents, this was significant at $p<0.001$. Male officers showed no statistical significance when comparing new parents to the controls (226.87 compared to 227.34). Female officer new parents averaged a higher score (232.01 compared to 230.51) than the controls, with significance at $p<0.01$.

New parents had lower BMIs than the controls, with significance at $p<0.001$ in the male enlisted (36.68 compared to 26.95), female enlisted (25.15 compared to 25.39), and male officers (25.78 compared to 26.50), and significance at $p<0.01$ for female officers (23.52 compared to 24.12).

New parents were younger compared to the controls for all four subgroups: male enlisted (24.66 versus 27.96), female enlisted (23.62 versus 27.23), male officer (31.69 versus 40.08), and female officer (30.02 versus 36.47).

New parents were more likely to be married than the controls for all four subgroups, with significance at $p<0.001$. Male enlisted (0.73 compared to 0.52), female enlisted (0.62 compared to 0.44), male officer (0.90 compared to 0.81), and female officer (0.75 compared to 0.57).

In all subgroups, new parents had lower average quantity of years' Time in Grade (TIG) compared to the controls. Male enlisted new parents averaged 1.70 years TIG compared to 2.49 in the control group. Female enlisted new parents averaged 1.57 years TIG compared to 2.32 in the control group. Male officer new parents averaged 2.02 years TIG compared to 3.45 in the control group. Female officers average 1.85 years TIG compared to 2.84 in the control group. These findings were significant for all groups at $p<0.001$.

New parents were more likely to be white than the control group for all subgroups analyzed. Male enlisted (0.58 compared to 0.55), female enlisted (0.54 compared to 0.51), male officer (0.83 compared to 0.80), and female officer (0.78 compared to 0.73). This was significant for all groups at $p<0.001$. These results also point to the large racial gap between officer and enlisted personnel, which is found throughout the military and not just in military medicine.

Finally, new parents have average AFQT percentiles higher than those in the control group. These scores are only recorded for enlisted personnel, as officers have no similar test score requirement for service. Male enlisted new parents average an AFQT percentile of 68.69 compared to 66.17 in the control group, while female enlisted new parents average 64.91 percentile compared to 62.82 in the control group. These results are significant at $p<0.001$.

B. OUTCOMES

We are interested in the impact of new parenthood on physical and professional performance. We study the following outcomes:

The Army Physical Fitness Test Score (APFT) / Navy Physical Readiness Test Score (PRT) is a combination of three timed events, testing upper body strength, abdominal strength, and cardiovascular fitness. These tests are conducted semi-annually. The APFT consists of maximum repetitions of pushups in two minutes, five minutes rest, maximum repetitions of sit ups in two minutes, five minutes rest, and a two mile run for the fastest time possible. Other cardiovascular fitness events may be substituted, but the run is the most common. Each of these three results in a score from 0 to 100, scaled specifically by age group and gender. For example, to achieve a score of 100 in the pushup's category, a 27 year old male would be required to complete 77 pushups, a 27 year old female would need to complete 50. A 37 year old male would be required to complete 73 pushups, while a 37 year old female would be required to complete 40. A minimum score of 60 in each of the three categories is required to pass the APFT.

The PRT is very similar. It substitutes curl ups for sit ups, and a 1.5 mile run for a 2 mile run. As with the APFT, the run is the standard option, but other cardiovascular events may be substituted. The PRT also considers the 500-yard/450-meter swim to be a standard option (though it is much less common than the run). In both the APFT and PRT, the combined score of the three events (maximum of 300 possible) is used as the measure of physical performance. Notably, the Army and Navy physical fitness test scoring standards change with age groups. At higher age groups, absolute performance standards are lower to achieve the same score. For example, a 20–24 year old male sailor must perform 77 pushups in two minutes to score “Excellent High,” while a 35–39 year old male sailor must perform 65 pushups in two minutes to achieve the same score.

We assessed body composition using body mass index (BMI). At each semiannual physical readiness testing cycle, height and weight are measured against a set of maximum weight per height standards for both Army and Navy personnel. Height and weight data were used to calculate body mass index, a parameter common to public health research as a surrogate measure for adiposity. Body mass index is a simple comparison of weight (in kilograms), divided by height (in meters) squared. Due to limitations on available body fat assessment data, BMI is the chosen outcome measure for body composition. BMI was available only for Navy personnel.

We used promotion points to assess job performance for Army service members. The Army calculates promotion points for its semi-centralized promotion categories of Sergeant (paygrade E5) and Staff Sergeant (paygrade E6). These points are earned in a variety of manners, including military training (weapons qualification and APFT scores), awards, decorations, and achievements, military education, civilian education, and promotion boards conducted at the unit-level. The points are calculated using the information on those events and are maintained in each individual’s personnel and training records. Promotions are based on requirements within a geographical area. Monthly reviews of the promotion eligibility lists are conducted by unit commanders. The Headquarters, Department of the Army (HQDA) establishes the monthly promotion cutoff scores and notifies field units of selected personnel. Minimum time in service (TIS) and time in grade (TIG) requirements for both Sergeant and Staff Sergeant promotion eligibility results in newly promoted or accessed individuals not recording scores in the database until this eligibility timeline is met (Headquarters, Department of the Army, 2019). The outcome variable for Army promotion points is current promotion points, as recorded in the quarterly observations.

Performance of Navy service members was assessed using evaluation scores. Each sailor in the Navy receives annual evaluations of performance using a standard set of categories, each on a 1 to 5 scale (or not observed). The sailor's commanding officer reviews and rates performance of the sailor in each of the following seven categories: professional knowledge, quality of work, command or organizational climate/equal opportunity, military bearing/character, personal job accomplishment/initiative, teamwork, leadership (Office of the Chief of Naval Personnel, 2019). Each trait is assigned a score from 1 to 5, with 1 indicating below standards, 2 progressing, 3 meets standards, 4 above standards, and 5 greatly exceeds standards. A trait may be assigned a value of "NOB" or "Not Observed" if the sailor's duties did not present an opportunity to perform in the given category or if the sailor has not been observed for an adequately long period by a commanding officer to assess that category. These category scores are averaged to provide an individual trait average for each evaluation. Any given commanding officer also has a cumulative average of evaluation scores tracked by paygrade (Office of the Chief of Naval Personnel, 2019). Within the Navy, the evaluation score of a sailor in comparison to his/her commanding officer's cumulative average is considered the most appropriate method to distinguish performance. For this research, commanding officer cumulative average scores were dropped if deemed unrealistic (less than or equal to 2.86). Then, we created a variable to compare sailor individual trait average to commanding officer cumulative average by dividing individual trait average by commanding officer cumulative average and multiplying by 100 to provide a percent scale. Then, 100 was subtracted from that variable to center an individual trait average equal to commanding officer's cumulative average at zero. This relative evaluation score is the outcome variable for the Navy enlisted personnel.

C. LIMITATIONS TO OUTCOME VARIABLES

We excluded any APFT scores within minus seven to plus six months from birth for Army service women identified as new mothers. This results in new mothers being observed starting at six months post-birth, which is the Army's requirement for post-birth resumption of the APFT.

Navy service women who become mothers are exempted from the physical fitness assessment for six months following the end of their maternity leave. This may result in them not participating in a PFA for over a year due to the semiannual cycle of the PFA.

The Navy's PRT score categories are an "all-or-nothing" within levels. For example, a male age 25–29 years is required to complete between 54 and 61 curl-ups to achieve a score of "Good Low." They would then receive 60 points on that section of the PRT. This can induce individuals to stop at the minimum number of curl-ups or push-ups required for a targeted category as they gain no additional points from completing 61 curl-ups vice 54.

The Veterinary Corps includes some warrant officers, but as these are the only warrant officers in the military medical community, we chose to exclude them from the analysis due to their unique status and small numbers.

The Army calculates promotion points for personnel in the paygrades of E4 and E5 and utilizes these points as a basis for promotion to E5 and E6 (respectively). For a variety of factors, updates of individual personnel records may have delays or missing information. This may lead to promotion points on record at a given date to be less than what has been achieved to date by the individual. For these analyses, we had to assume promotion point records were as accurate as possible, with no biases in the distribution of any discrepancies.

We had to assume for both Army and Navy personnel that any individual who had no dependent data available had no children, and thus were included in the control groups. We removed individuals known to have previously had children from the analysis. We worked under the assumption that the Defense Eligibility and Enrollment System database is updated only when new dependents are added to an individual's record, and thus may be inaccurate in reporting dependents acquired prior to the time period under analysis. However, any individual who experienced the birth of a new child during the study timeframe should have had this birth recorded under this assumption.

We now describe additional variables considered for analysis of this population. Individuals were coded as married if marital status was coded as such and not married if status was coded as divorced, annulled, separated, or never married. Race was not clearly identified in the data; we assumed the numerically largest group was White/Caucasian. This is the only clearly identified group due to known demographics of military personnel. This resulted in analyzing our population by white versus non-white personnel. Individuals who had code 999, which we assumed to be missing or preferred not to respond, were excluded from the race/ethnicity analysis.

Married versus unmarried and white versus non-white were found to have no significance in determining the effects of parenthood on our outcome measures, and we dropped them from our final regression equation.

D. METHODOLOGY

Stata 15 (Statacorp, LLC 1996–2021) was used for the statistical analysis of the dataset. De-identified data from multiple databases within the Army Analytics Group Person-Data Environment were cleaned of unnecessary information, checked for errors, and removed of duplicates. We merged data across multiple personnel datasets from the Department of Defense, Department of the Army, and Department of the Navy using each servicemember's unique person identifier code. These include databases containing service member demographics, dependents, training, performance, fitness, and administrative information.

Linear regression analysis was performed on the population of interest: active duty military medical personnel with observations between 2013–2019. Separate models were run for gender, officer/enlisted status, and officer corps were both Army and Navy personnel, using individual fixed effects to account for constant characteristics within individuals across time. For the physical fitness and body composition analyses, age was added as a covariate to the models. For the job performance analyses, time in grade was added as a covariate to the models.

We ran the following model separately for male enlisted, female enlisted, male officers, or female officers:

E. BASE MODEL

$$Y_{it} = \sum_{k \geq -m}^{l} C_{it}^{k}\,\delta_k + A_{it}^{j}\theta_j + X_{it}\beta + \gamma_i + \tau_t + \varepsilon_{it}$$

Each outcome measurement, Y_{it} in the Base Model includes the outcome for person i at time t for parents and non-parents. The outcomes included APFT score, Navy PRT score, and BMI (for Navy only). The variables included in $C_{it}^{k}\delta_k$ represent dummy variables for semi-annual physical fitness assessment cycles pre- and post-birth. These variables range from m semiannual cycles before birth to l semi-annual cycles after birth. The model we use has m =-8 and l =8. The variables included in A_{it}^{j} represent dummy variables for age in years of the member (for the physical fitness analyses) and the time in grade (for the performance analysis). X_{it} represents time-changing individual characteristics (e.g., rank, time in service, location). We include individual fixed effects to account for time invariant characteristics of individuals. We also include time fixed effects to account for changes in the outcome that vary over time for all individuals. Thus, the primary coefficient of interest is δ_k, which represents the estimated effect of childbirth on parents' outcomes k cycles before and after birth, relative to the parents' base level (two cycles prior to birth), after accounting for service-wide changes and the time-changing individual characteristics. Outcomes are clustered by individual to account for heteroskedasticity.

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V. RESULTS

We begin by showing the relative differences between our subgroups by age at birth of an individual's first child. This orients the subsequent outcome analyses, as age is a significant and relevant variable when considering physical performance measures. We then present our findings on physical fitness measures for the Army and the Navy. Next, we present our findings on Body Mass Index outcomes for the Navy. Finally, we describe our attempts to analyze job performance outcomes for the Army and the Navy.

A. AGE

Age is an important variable to control for when studying physical performance, as the military brackets its fitness test performance categories based on age of the individual tested. The age at which individuals typically have their first child also varies based on education, and the enlisted/officer differentiation by education provides an opportunity to assess the relative impacts of childbirth by group. Enlisted service members in the Army and Navy medical communities have children at earlier ages than their officer counterparts. Enlisted personnel typically have their first child in their early 20s, while officers tend to have their first child in the late 20s or early 30s. Graphical representations can be found in Figures 3 and 4. These results are typical of the broader population of the United States, where individuals with college degrees tend to delay parenthood compared to those without college degrees. Each Army and Navy medical officer community requires at least a bachelor's degree to commission, while enlisted service has no college requirements for entry.

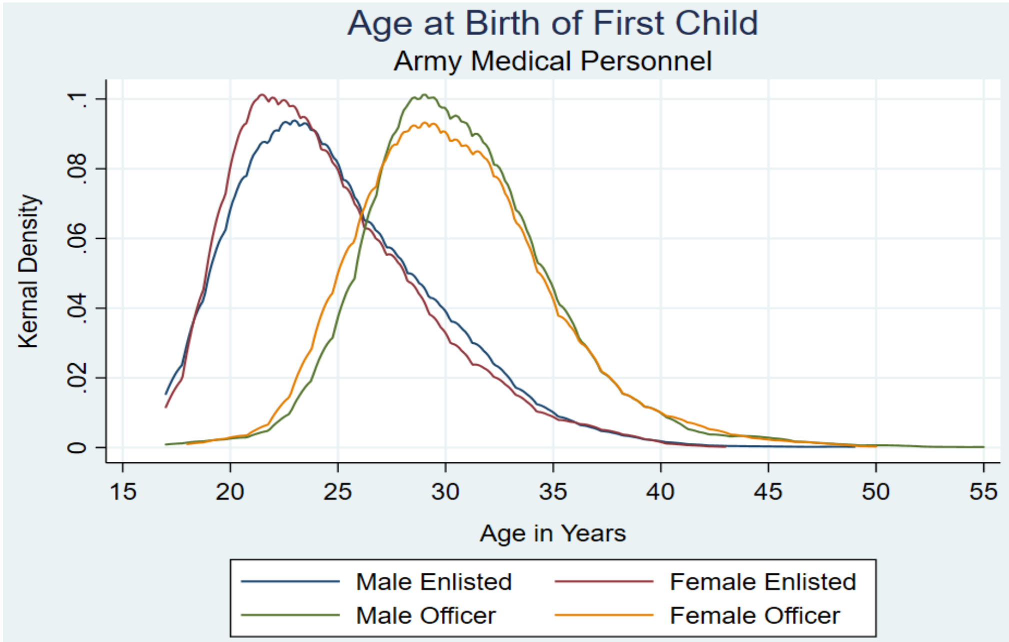


Figure 3. Age at Birth of First Child, Army Medical Personnel

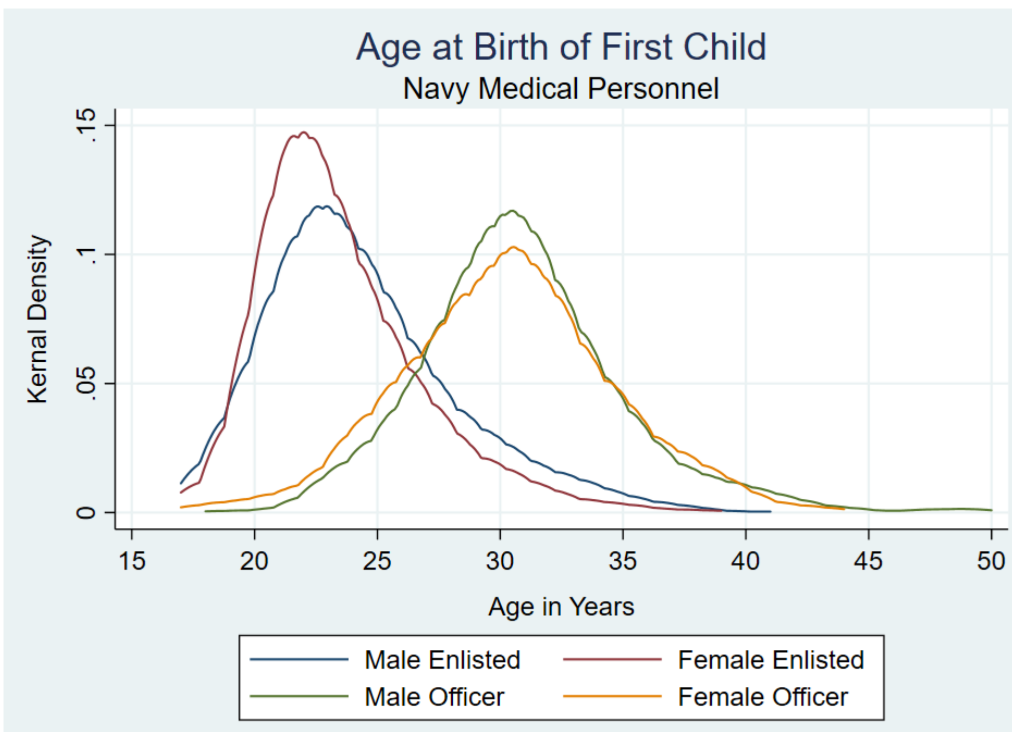


Figure 4. Age at Birth of First Child, Navy Medical Personnel

B. PHYSICAL FITNESS RESULTS

1. Army

We analyzed the physical fitness outcomes for Army personnel using the total Army Physical Fitness Test (APFT) score, which as mentioned in the Data chapter combines upper body, core, and cardiovascular event scores. Table 3 in Appendix shows the results of our analysis by subgroup, while Figures 5 and 6 plot the change in APFT score by cycle, relative to birth and baseline. Figures 5 and 6 show graphical representation of our results. The vertical axes in Figures 5 and 6 are measured in point changes relative to baseline, which was set at two APFT cycles (approximately one year) prior to birth. These values correspond to the coefficients of the expected APFT cycle relative to birth for each subgroup.

All subgroups in the Army population studied showed statistically significant declines at the $p<0.05$ level in APFT scores compared to baseline (two cycles prior to birth), beginning one cycle prior to birth for male enlisted, at birth for male officers and the first cycle after birth for females in both officer and enlisted categories.

Male enlisted soldiers scored 3.192 ($p<0.01$) points lower than baseline one cycle before birth, 6.317 ($p<0.001$) points lower in the cycle at birth of first child, 3.681 ($p<0.01$) points lower one cycle post birth, and 1.663 ($p<0.05$) points lower two cycles post birth (Figure 5). For example, a new parent in this group at the average age of birth of first child, 26, would be expected to score 2.6% (235/241) lower than a non-parent in the cycle of birth. Male enlisted also have predicted APFT scores compared to baseline of 5.573 ($p<0.01$) points lower at seven cycles prior to birth and 3.900 ($p<0.05$) points lower at eight or more APFT cycles prior to birth. The number of observations for this group was larger than the number of observations for the other time periods prior to birth due to including all observed APFTs prior to eight cycles before birth in one category to constrain the analysis to the time periods within four years before and after the birth of an individual's first child.

Female enlisted soldiers show a trend toward increasing APFT scores in the periods prior to birth, but this effect is not statistically significant (see Figure 5). After birth, female enlisted soldiers have a statistically significant decrease in APFT scores for three cycles. Compared to baseline (two cycles prior to birth), female enlisted soldiers are expected to score 22.968 ($p<0.001$), 9.730 ($p<0.001$), and 7.438 ($p<0.01$) points lower on the APFT in the first, second, and third APFT cycle post birth, respectively. For example, at age 25, which is the average age of new parents in this subgroup, a new mother in the cycle after birth would score an estimated 9.3% (227/250) lower on her APFT compared to an equally aged non-parent. They continue to show a trend of lower, but statistically insignificant, APFT scores through eight cycles after birth.

Male officers show a significant predicted decline of 2.819 ($p<0.05$) points lower than baseline at the APFT cycle of birth only (see Figure 6). For a new parent at age 32, this is an expected 1.1% (252/255) decline relative to a non-parent. Male officers show a trend of decreases in APFT scores through two APFT cycles after birth that is not statistically significant. In comparison, female officers show a trend of statistically insignificant increases in their APFT scores up to baseline (two cycles prior to birth), and statistically significant decreases in score after birth up until seven APFT cycles post-birth of their first child (see Figure 6). Female officers are predicted to score 18.350 ($p<0.001$), 12.288 ($p<0.001$), 8.847 ($p<0.001$), 8.417 ($p<0.001$), 9.433 ($p<0.001$), 8.798 ($p<0.01$), and 9.235 ($p<0.05$) points lower on the APFT than baseline in the first, second, third, fourth, fifth, sixth, and seventh APFT cycles after birth, respectively. For example, at the average age at birth for a new parent female officer, 31, these new mothers are expected to see a decline in their APFT score of 8% (235/253) compared to non-mothers at the same age at one APFT cycle post birth.

Data retrieved from PDE system, August 2020-March 2021.

Figure 5. Change in APFT Score, Army Enlisted Medical Personnel

Data retrieved from PDE system, August 2020-March 2021.

Figure 6. Change in APFT Score, Army Officer Medical Personnel

We conducted subgroup analysis on each of the five officer Corps in Army Medicine: Medical Corps, Dental Corps, Nurse Corps, Medical Service Corps, and Veterinary Corps. We found similar results as those for the generalized male and female officer sub-groups.

2. Navy

We analyzed the physical fitness outcomes for Navy personnel using total Physical Readiness Test (PRT) score, which combines upper body, core, and cardiovascular event scores. Table 4 in Appendix shows the results of the analysis by subgroup, while Figures 7 and 8 plot the change in PRT score by cycle, relative to birth and baseline for each subgroup in our analysis. The vertical axes in Figures 7 and 8 are measured in total points from the reference, which was set at two PFA cycles (approximately one year) prior to birth. These values correspond to the coefficients of the expected PFA cycle relative to pre-

pregnancy for each subgroup. We found that age was a significant predictor for almost all ages in all four subgroups analyzed.

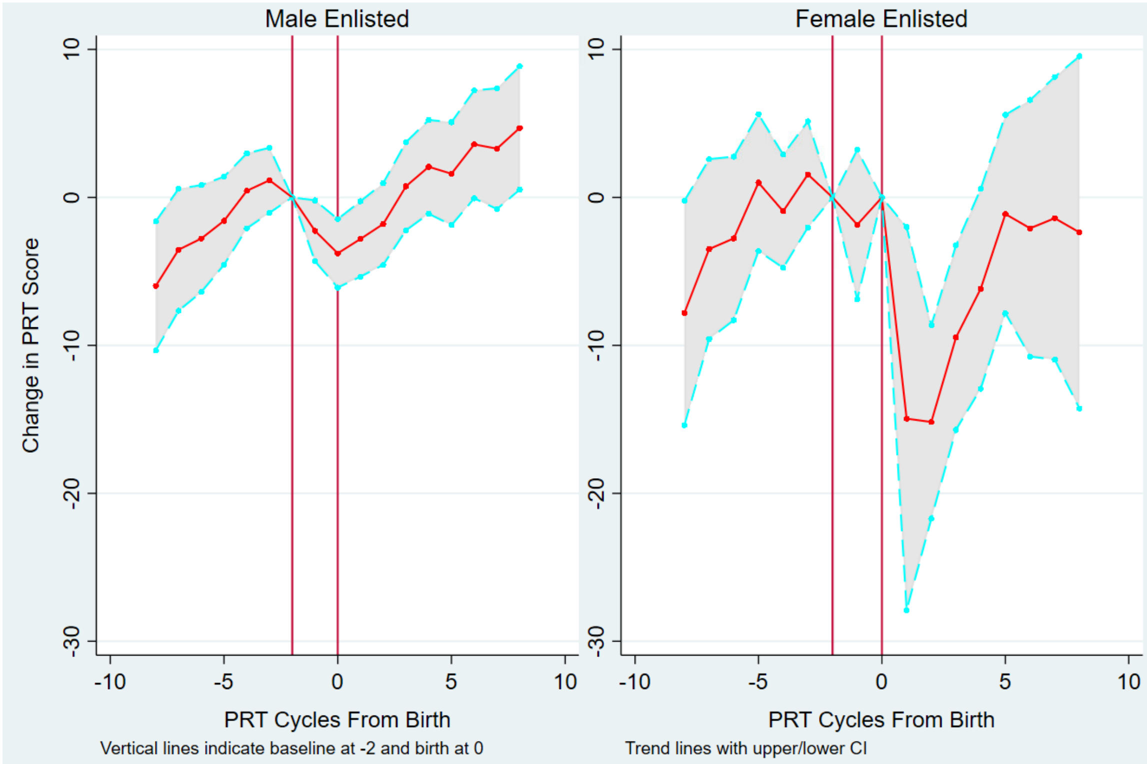
We found that all subgroups showed a decline in total PRT score in the PFA cycle immediately following the birth of an individual's first child, however the decline for male officers is not statistically significant. Male enlisted personnel scored 2.262 ($p<0.05$), 3.777 ($p<0.01$), and 2.806 ($p<0.05$) points lower on the PRT compared to baseline (two cycles prior to birth) at one cycle prior to birth, the PFA cycle nearest to birth, and one cycle after birth of the first child, respectively. Additionally, male enlisted personnel scored 5.979 points lower ($p<0.01$) than baseline at eight or more PFA cycles prior, with a trend toward higher PRT scores up until three cycles prior to birth (see Figure 7). Male officers did not show any statistically significant decreases in PRT score within three cycles before or after birth of the first child. Male officers did score 8.093 and 8.122 points lower ($p<0.01$) than baseline at seven and eight or more PFA cycles prior to birth, respectively, with a trend upward toward the baseline (see Figure 8).

Females in both the officer and enlisted medical career fields see larger relative decreases in their PRT scores after birth compared to men, and those scores trend lower than the baseline (two cycles prior to birth) throughout the next eight PFA cycles (see Figures 7 and 8). Decreases in PRT scores are statistically significant at $p<0.05$ through three PFA cycles after birth for both groups. Female enlisted personnel score 14.950 ($p<0.05$), 15.177 ($p<0.001$), and 9.459 ($p<0.01$) points lower on the PRT than baseline on PFA cycles one, two, and three following birth, respectively. This decrease in PRT score that is more than five times that of their male counterparts. Female officers score 14.404 ($p<0.01$), 9.018 ($p<0.01$), and 7.597 ($p<0.05$) points lower on the PRT compared to baseline on PFA cycles one, two, ad three following birth, respectively. This represents a decrease that is more than 12 times greater than their male counterparts.

In the perspective of the scale most commonly referenced by the Navy, female enlisted personnel could be expected to lose one category in one of the three events of the PRT (as in moving from Excellent High to Good High in a single event), or one level across all three events (as in moving from Excellent High to Excellent Medium in all three events). For example, if an individual had scored an overall Excellent Medium prior to the birth of their first child, the expected result in the PFA cycle after birth would be an overall Excellent Low for female enlisted personnel. Female officers could expect to see their PRT results drop by less than one category overall, with potential drops of up to one level in each of two events, or two levels in one event. If these individuals were scoring in the Good Low or lower prior to the birth of their first child, they would be expected to score in the Satisfactory or Probationary Category, resulting in placement on the Fitness Enhancement Program (Navy Physical Readiness Program, 2019). By five PFA cycles post-birth, female enlisted personnel are not expected to have a potential individual event-level impact on their overall test scores, while female officers are not expected to have a potential individual event-level effect beginning at six cycles post-birth.

Male enlisted personnel have a significant increase of 4.696 ($p<0.05$) points compared to baseline (two cycles prior to birth) in their predicted PRT score beginning at eight PFA cycles after the birth of their first child. However, this increase represents an improvement of less than one level of PRT score, which is calculated in increments of 5. Male officers show a significant increase of 5.715 ($p<0.05$) points compared to baseline in their predicted PRT score beginning at six PFA cycles after the birth of their first child. For male officers, score continue to trend up, with a predicted increase of 7.102 ($p<0.05$) and 11.106 ($p<0.001$) points above baseline at seven and eight or more cycles post birth of the first child, respectively. This represents an increase in score category from one to two levels of an individual event between six to eight or more PFA cycles post-birth.

Additional subgroup analyses were conducted on each of the four officer Corps represented in Navy Medicine: Medical Corps, Dental Corps, Nurse Corps, and Medical Service Corps. We found similar results as we did for the generalized male and female officer sub-groups.



Data retrieved from PDE system, August 2020-March 2021.

Figure 7. Change in PRT Score, Navy Enlisted Medical Personnel

Data retrieved from PDE system, August 2020-March 2021.

Figure 8. Change in PRT Score, Navy Officer Medical Personnel

C. BMI RESULTS

1. Army

We do not analyze Army BMI because of the volume and quality of Army body composition data available to us. It lists all individuals meeting weight for height standards as "Pass" vice providing the actual height and weight measurements. As such, any body composition analysis for the Army population in our research would be limited to those who exceeded the weight for height standards. This subgroup is not likely to be representative of the population of interest, as those who exceed weight for standards are expected to either have excess body fat and/or greater than average lean tissue.

2. Navy

We analyzed Body Mass Index for Navy personnel by PFA cycle relative to two cycles (one year) prior to the birth of an individual's first child. Results are presented in Table 5 in Appendix.

The only significant effects in BMI relative to baseline were observed for male enlisted. This population had a 0.222 kg/m^2 ($p<0.05$) higher than baseline (two cycles prior to birth) BMI prediction at seven PFA cycles before birth. Beginning one PFA cycle after birth of the first child, and up to eight or more cycles post birth, male enlisted were predicted to have decreases in BMI of between 0.218 and 0.846 kg/m^2 ($p<0.001$). Although statistically significant, these effects possess minimal practical relevance, representing a loss of less than six pounds body weight compared to baseline for an average height U.S. male (69 inches) at eight or more PFA cycles post birth. All other subgroups showed no significant changes to BMI at any time points relative to baseline.

Age is a significant predictor of BMI at $p<0.05$ in this model for all ages, except male officers ages 22–28. All subgroups show increases over time, with varying effect sizes. Male officers of reference age have a higher relative BMI but show smaller increases at older ages. Conversely, enlisted personnel of both genders and female officers have lower BMIs for the reference age, with larger effects as age increases. Male officers, reference age 21 years old, have average BMI of 24.423. Male enlisted, reference age 17, have average BMI of 20.657. Female enlisted, reference age 18, have average BMI of 21.015. Female officers, reference age 20, have average BMI of 21.569. Effects of age are more pronounced for enlisted personnel as compared to their equivalently aged officer counterparts, with male enlisted showing approximately three times larger effect size at comparable ages (predicted increase of 12.395 kg/m^2 versus 3.841 kg/m^2 at age 50, $p<0.001$), while female enlisted show approximately two times effect as compared to equivalently aged female officers (predicted increase of 11.666 kg/m^2 vs. 5.175 kg/m^2 at age 44, $p<0.001$).

D. JOB PERFORMANCE

We were unable to study job performance for the Army or Navy because of data constraints. The main issue for the Army is it stores and calculates promotion points for those being looked at for promotion for the ranks of E5 and above, while the majority of enlisted soldiers are having their first children at ages that are most likely associated with paygrades E4 and below. Promotion points are a cumulative measure, and there are no widespread instances where points would be deducted from individuals due to life events such as birth. Time in Grade (TIG) is a key factor in initial eligibility for promotion, and this is heavily correlated with time relative to the birth of an individual's first child. Due to these limitations, we were unable to identify any trends that could be separated from biases generated from the manner in which promotion points are calculated. No officer evaluation reports were available for analysis.

In contrast, we were unable to study Navy enlisted performance because the sample size was insufficient to identify any effects. The number of evaluations of members at or near the birth of their first child was exceptionally low, and highly unlikely to be representative of Navy medical enlisted personnel more broadly. The data repository contains few evaluations for ranks E4 and below. The average age at first birth of enlisted personnel most commonly aligns with average ages of personnel at paygrades E4 and below. No officer fitness reports were available for analysis.

VI. DISCUSSION

This research adds to an emerging, yet growing, body of literature that identifies new parenthood as at least a short-term impediment to physical health and performance for both parents. Our findings also have implications for the physical health and performance of military members and medical professionals, two populations known to be at risk for multiple health issues, acutely and chronically (Chiou et al., 2014; Hawker, 2012; Helfand & Mukamal, 2013; Hoerster et al., 2012; Holtzclaw et al., 2020; Kramer & Son, 2016; Lehavot et al., 2012; Malik et al., 2011; Mohanty et al., 2019). Moreover, considering the direct link between physical fitness and cardiovascular health (Fardman et al., 2020; Wang et al., 2020), these results have implications for medical costs, both short and long-term, of a population with impaired physical fitness.

This research identifies a clear link between the strains of new parenthood on the physical performance of military medical personnel. Among men, the effects are more short-lived than among women, who perform worse on physical fitness tests for two or more years after childbirth. Women face both the initial physiological strain of childbirth itself and take on a disproportionately greater role in childcare long-term compared to fathers. Research has also shown routinely that mothers have less time for leisure, including voluntary physical activity, than fathers. As such, the differential impacts observed by gender are directly in-line with expectations, as mothers perhaps face more constraints upon their abilities to recover, return to prior activity levels and fitness.

Over time, we also found that males in the Navy showed significant increases in their PRT scores compared to their baseline, pre-pregnancy levels. While we do not know the cause of this improvement, civilian literature has shown that once men become fathers, they tend to accelerate their career progression through increased earnings and work hours (Glauber, 2008; Killewald, 2013). PRT results in the Navy influence promotion opportunities for both the enlisted and officer communities, so this may be one influence on the increasing nature of male father PRT results. Due to relatively small sample sizes in the time periods before and after we observe the birth of an individual’s first child, additional research into the effect of marriage and impending fatherhood on the physical health and performance of individuals is needed.

Our results are also in agreement with a recent study on Marine Corps personnel experiencing the birth of their first child (Larson, 2020). Marine fathers return to baseline, pre-pregnancy fitness scores by 18 months post-birth, equivalent to three APFT/PRT cycles in our study. For female Marines, return to baseline physical performance does not occur until the end of the study window, which was 24 months. This is equivalent to four APFT/PRT cycles in our study. For direct comparison, the female soldiers and sailors showed significant decreases in APFT/PRT scores for three to six cycles post-birth of their first child.

Our results also present an uncommon finding pertaining to physical health and performance across levels of education. As previously discussed, officers tend to join the military at older ages compared to their enlisted counterparts. Especially in the medical community, officers tend to have significantly higher levels of educational achievement (one or more graduate degrees) simply due to the requirements for entry into the service in one of these specialties. While the majority of epidemiological data suggest that health outcomes and physical fitness are poorer among less educated Americans when compared to college educated Americans, our results show roughly equivocal impacts to physical performance from new parenthood across enlisted service members and officers. The results of our BMI analyses suggest a small effect of new parenthood on adiposity among male enlisted, which is not observed among female enlisted or either sex of officers. Our findings with regard to BMI are relatively similar to civilian literature on this subject, where less educated individuals within healthcare are more likely to be overweight compared to their more highly educated counterparts (Helfand & Mukamal, 2013).

Multiple factors highly specific to military medicine may influence the minimal differences between officer and enlisted physical health and performance observed in this study. Military medicine tends to have enlisted and officer personnel working very closely for a great deal of their careers, with more direct communication between officers and enlisted members than may be common for equivalent healthcare workers in the civilian setting. Thus, the setting and work style may create peer and leader effects across both groups in a similar manner and mitigate some of the differences in physical health and performance between medical officers and enlisted members.

We found age to be a significant predictor as it relates to the physical health outcomes of this population. The Army and Navy use age categories in their physical fitness tests, with decreasing absolute performance standards to achieve the same relative performance score, as discussed previously. Age not only presents as a significant, positive predictor of APFT/PRT performance, it does so with increasingly large effect size as age increases. Considering that most literature observes decreasing physical fitness with age (Cameron et al., 2018; Dawes et al., 2017; Kirlin et al., 2017; Lockie et al., 2019), the impact of age observed in this study raises questions as to the nature of physical fitness within the military, or at least military medicine specifically. These effects could be explained by selection, with those who are more fit or engage more willingly in fitness improvement deciding to remain in military service for longer than the less fit and those who enjoy fitness less. One may contend that the less fit are attriting due to failure of the APFT/PRT, but the attrition rate due to body composition or fitness test failures in the Army and Navy fluctuates between only 1–6.5% for any individual APFT/PRT cycle (Lennon et al., 2015; Russell et al., 2019). Considering a member must fail three body composition or fitness tests to be forced to attrite, this is not a sufficient independent explanation for the effects observed in this study.

These effects could also be explained by a combination of career ambition and selection, in which personnel gain greater interest in promoting within the military, place greater emphasis on their fitness to score better on the test, and thus improve with age. Meanwhile, those less interested in a military career place less emphasis on improvement in the fitness test to enhance promotion, and voluntarily attrite or are forced to attrite due to high year tenure. The impacts of age observed in this study may also be explained by issues with the fitness test events, and the age scaling for scoring. As members conduct more APFT/PRTs over the course of their careers, they may become better at training specifically to the test (vice general fitness) and improve with successive attempts as they age. Possibly acting solely or in combination with any of the factors noted above, scaling of absolute performance by age may be inappropriate. The standards for younger members may be scaled inappropriately difficult, standards for older members may be scaled inappropriately easy, or some combination therein. This latter explanation presents as the simplest explanation for the effects observed in this study and fits the classic Occam's razor. As such, we suggest further investigation into adjustments to these age and performance brackets to better assess overall health and performance moving forward.

A. LIMITATIONS

Despite the size and scale of the data used in the analysis, we want to highlight a few key limitations of our study. The original intent of this thesis was to analyze the effects of parenthood on retention as well as performance of medical personnel in the Army, Navy, and Air Force. This effort was ultimately limited based on the availability and quality of data as well as the limited time inherent in completing theses at Naval Postgraduate School. Unfortunately, our databases lacked any data pertinent to Air Force medical personnel.

Among Army and Navy officer data, promotion and/or fitness report data was not present. We were unable to identify appropriate data to assess officer performance over this period for either Army or Navy personnel. Navy officer promotion eligibility and selection data was available to us, however no method of matching this data to the other data for the individuals was possible. Data on Army officer promotion eligibility and selection or officer evaluations, and Navy officer fitness reports were not available to us at the time of our study. As such, we limited our analysis to enlisted performance outcomes. The database holding enlisted evaluations for the Navy was missing large quantities of data for paygrades E4 and below, ranks which correspond to the most common ages for enlisted members to have their first child. Ultimately, this limited our ability to draw any causal estimates related to parenthood's effect on job performance.

In the Army, individuals are expected to validate their individual training and personnel records, leading to potential for some Soldiers who are less diligent about maintaining their record having delayed or missing promotion points entered into their record. This may be especially true of new parents, who are dealing with major life changes and may not prioritize their individual records management. Due to the limited number of first-time parents being observed in these paygrades, the results of this portion of the analysis lacked sufficient power for robust causal estimates to be concluded.

Furthermore, the timescale of the data was 2013–2019, a brief enough period to inherently limit the utility of any analysis of retention/attrition. An appropriate analysis on potential behavioral changes with regards to attrition and retention of medical personnel who become new parents was unable to be conducted with a dataset limited to six years. Future researchers would benefit from expanded data available in the system to further explore these effects.

There is some concern over selection bias over time in this data as those who are more fit have lower BMI and are thus likely to perform better on these standardized tests of physical readiness. Those individuals who have an easier time retaining their physical fitness levels in a system that rewards this outcome may be more likely to remain in the military than those who struggle to maintain their fitness levels and or weight. These effects become more pronounced as free time diminishes with the onset of new parenthood. New parenthood may be a leading indicator of intent to attrite among some portions of the military population. Poor performers and/or those never intending to complete a long career with the military may intentionally plan to have their first child shortly before they become eligible to attrite. This may skew those individuals towards those more motivated to perform at a high level in all aspects of a military career, of which physical readiness is a readily observable and measurable component.

Height and weight data were missing for Army personnel, as the Army does not record these measurements if an individual passes the weight for height requirement. As such, those personnel with a body fat assessment within these data are fewer in number than the total and biased toward overweight and/or heavily muscled personnel. This results in an inappropriate sample from which to generalize any changes to body fat resulting from new parenthood. This limited our analysis of BMI changes to Navy personnel only. Height and weight data were available for the Navy personnel, which allowed us to track body mass index (BMI) over time. However, BMI is not considered as effective a measure of adiposity as waist circumference or the Navy body fat measurement (affectionately known as the “rope and choke”), which consists of a calculation based on neck, waist, and hip (female only) circumference measurements.

For the analyses performed, sample generalizability and data integrity are strong in terms of extrapolation to military medicine at large. These analyses represent the entirety of Army and Navy medical personnel who became new parents or were childless from 2013–2019. However, given the unique nature of both military service and healthcare occupations, generalization of these findings to other professions in the civilian sector should be done very cautiously. Yet, our findings are similar to research on other military parents, as well as other medical professionals, suggesting these results may be representative of the impacts of new parenthood on physical performance to military personnel more broadly, and to medical personnel more broadly.

VII. CONCLUSION

Our study shows that new parenthood reduces physical performance of military medical personnel. These effects are by far more pronounced among females, both officer and enlisted members. These effects are also far more long-lived among female officers and enlisted than among their male counterparts. Mothers in military medicine show marked decreases in performance immediately after birth of their first child, with lasting effects up to three years post childbirth.

A. RECOMMENDATIONS FOR FUTURE RESEARCH

The Navy and Army have both recently updated their physical readiness tests and standards. The Navy has replaced curl-ups as the test event for core strength with planks (Navy Physical Readiness Program, 2020). The Army has replaced the APFT with the Army Combat Fitness Test (Headquarters, Department of the Army, 2020). These recent policy changes provide an opportunity in the near future to explore the effects of these new measures of physical health and performance for individuals in this population. Moreover, physical performance among individuals who become new parents under the new requirements may be compared to those who were analyzed in this and similar studies.

As Air Force personnel data was largely unavailable for our research, replication of this study among Air Force personnel would be useful to identify similar or conflicting trends in the impact of new parenthood across the service branches.

We recommend more research on the effects of new parenthood (or parenthood in general) on performance evaluation measures for both enlisted and officer personnel. We suggest further analysis of promotion probability to O-6 for Medical and Dental Corps Officers by parental status and gender. The Department of Defense has personnel management exemptions for medical and dental officers with regards to rank and force structure requirements, resulting in nearly 100% promotions to ranks up to O-5 (Rostker et al., 1993). The impacts of new parenthood on promotion should be explored among other medical officers beginning at the O-4 level. Given access to a full dataset of enlisted evaluations and officer fitness reports, the impacts of new parenthood on military medical personnel could be directly examined in a similar manner to that of physical performance measured within this study. This research could be extremely informative, with policy implications for leave, managerial flexibility, and support programs for new military parents.

Analyses of the impacts of new parenthood to military and medical personnel are warranted. Given access to a broader timeline of personnel data would allow for more detailed and far-reaching analysis of key areas of interest to policy makers for both military and healthcare, such as the impact of parenthood on performance and retention of highly skilled, in-demand professionals. A larger time scale would additionally benefit models of changes to job performance within this population (assuming the data is available), increasing power and generalizability.

Further research into potential attrition due to childcare concerns is warranted. Access to childcare is consistently cited as a major concern among military parents (Bandy, 2019; Gates et al., 2006; Huffman et al., 2016; Kamarck, 2020; King et al., 2019). Military medical personnel, who may be working non-traditional schedules, may face additional challenges in childcare that alter performance, health behaviors, retention decisions. Research may explore current trends and issues across military childcare, among the military medical population explicitly, and may expand upon previous pilot programs (US Army Public Health Center, 2019) studied to support new parents in their return to duty.

Another potential opportunity for research involves identifying and expanding options for part-time service. Part-time service may be of greatest value for critical wartime specialists who become mothers. These practitioners may desire a temporary transition to part-time work for a period after childbirth. This may include a modification of the currently established career intermission program, a variation of Selected Reserve service, or a new part-time service agreement that would allow the military to retain highly trained individuals who would otherwise attrite.

The Nurse Corps, Medical Service Corps, and enlisted personnel of both services have wide variation in the types of duties, educational requirements, and operational/wartime impact of their positions. This variation provides additional opportunities for targeted analysis of promotion, retention, health, and performance impacts of parenthood. Highly detailed analyses may inform more specific and targeted personnel policies in the Department of Defense in order to attract and retain highly qualified and specialized professionals.

B. RECOMMENDATIONS FOR ARMY / NAVY POLICY

The Army and Navy have similar timelines in which they expect new mothers to regain their physical fitness and return to duty. New mothers in the Army are placed on a limited duty profile for 45 days after they give birth. At the end of this 45-day period they are given 90 days to exercise on their own, with a goal of returning to unit physical training activities. These requirements include a passing score on the APFT and height/weight within Army body composition standards by 180 days post-birth (Headquarters, Department of the Army, 2020). To support new mothers, the Army utilizes the P3T program, a holistic approach to health and fitness during and after pregnancy (US Army Public Health Center, 2019).

Post-partum servicewomen in the Navy are exempt from the PFA for six months following the end of their maternity leave. They are required to participate in the PFA cycle following the end of that six month period (for example, if their six month period falls in Cycle 1 of a Calendar Year, they will be required to participate in Cycle 2 PFA of that same year) (Office of the Chief of Naval Operations, 2018, 2019). This policy can affect mothers very differently, even with similar timing of birth events. For example, a mother whose maternity leave ends on December 31, 2015, would be required to participate in the 2nd PFA cycle of 2016, while a mother whose maternity leave ends on January 4, 2016 would be exempt from that same cycle. A more even treatment of mothers would be an exemption from a specific number of PFA cycles following the end of maternity leave, assuming an uncomplicated birth with no undue health effects.

Per (Office of the Chief of Naval Operations, 2019), “Commanding officers (COs) are responsible and accountable for the physical fitness of their personnel and shall establish and maintain an effective year-round physical readiness program. Physical fitness shall be integrated into the workweek, consistent with mission and operational requirements.” The results of this study highlight the importance of ensuring service members, especially new mothers, are able to exercise appropriately in order to maintain their physical fitness and health. As new mothers are not eligible for deployment for one year post-birth, the overwhelming majority of new mothers are assigned to shore activities, with minimal operational requirements that would interfere with COs ensuring that their Sailors are engaging in the mandated fitness requirements during working hours. Expecting parents to engage in fitness activities outside of normal working hours puts the time of new parents directly in conflict with child-rearing and sleep, even as physical training is mandated by the service. Failure to incorporate physical fitness into the standard work week sets parents up to fail in their attempts to balance the rigors of military life with the challenges of raising young children.

The Navy can create a similar program to the Army’s P3T program to help new mothers throughout their pregnancies and postpartum to help return to physical readiness and health. Adoption of such a program represents a relatively quick and easy policy change that can be implemented with minimal cost.

The authors are both Navy Officers, and do not have in-depth Army cultural exposure, and thus will limit commentary regarding the Army’s culture of family and parenthood. A frequent saying in the Navy is that “your family wasn’t issued in your seabag,” which works to deter individuals from seeking assistance with parenthood and family concerns. The variety of family and personal support programs available to service members are enormous in their depth and breadth but are perhaps not utilized to their fullest extent due to these cultural challenges. These endemic cultural norms warrant redress from top-level leadership. Meanwhile, managerial level flexibility to allow lighter workload for new parents may be implemented in a variety of settings Navy-wide.

Child care availability is a chronic issue at many military bases, with long wait lists that force service members to either find care in the community, or their spouse to limit or cease outside employment (Gates et al., 2006; Kamarck, 2020). This can put financial strain on these individuals, as frequently military bases are located in high cost of living areas, especially in the Navy. Expanding on-site childcare has been an ongoing concern of the DOD for years, and previous studies have shown that the lack of available childcare is a major driver of female attrition (Bandy, 2019; Huffman et al., 2016; King et al., 2019). Studying attrition of military females from bases with and without adequate childcare on-site could provide additional analytic support for investing resources in this benefit, which would provide savings in the reduced cost of attracting and training new individuals into the services.

The benefits of paternity leave on the health and recovery of new mothers have been shown in other Western nations (Persson & Rossin-Slater, 2019). The Department of Defense recently expanded paternity leave to two weeks, but reexamination of the adequacy of this entitlement is warranted. The effects of sleep deprivation on new parents imply that those fathers returning to work shortly after experiencing a new birth are likely not working to their full capability. Particularly in operational, industrial, or mechanical environments, any reduction in cognitive function due to lack of sleep may lead to increased risk of mishaps or safety concerns. A cost-benefit analysis on expanding paternity leave with the expected life cycle health savings and safety improvements may provide additional analytical support to expansion of the paternity program. Yet, civilian employers of highly skilled and educated workers increasingly offer expanded parental leave benefits, and in order to remain competitive, the Department of Defense may need to follow suit regardless.

We strongly suggest, due to these findings, the Department of Defense increase attention to implementing policies to assist new parents in the transition to parenthood. Military personnel represent a significant investment on the part of the military and designing policies to best attract and retain qualified and motivated individuals are crucial. Policies pertaining to part time military service options, and other incentives or programs should be explored as additional research becomes available pertaining to the effects of new parenthood on performance, health, and retention.

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APPENDIX: TABLES OF FITNESS AND BMI OUTCOMES

Table 3. Army PFT Results by Male/Female and Officer/Enlisted Medical Personnel

Army PFT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
APFT Score				
8+ APFT Cycles Before Birth	-5.573** (1.881)	-3.519 (3.379)	-0.464 (1.971)	-1.339 (2.562)
7 APFT Cycles Before Birth	-3.900* (1.667)	-2.201 (3.137)	-1.542 (1.834)	0.981 (2.147)
6 APFT Cycles Before Birth	-2.565 (1.403)	1.798 (2.605)	-1.288 (1.608)	-0.332 (1.802)
5 APFT Cycles Before Birth	-2.377 (1.295)	0.987 (2.311)	-0.580 (1.330)	0.577 (1.585)
4 APFT Cycles Before Birth	-2.024 (1.238)	0.643 (1.979)	-1.281 (1.164)	0.702 (1.332)
3 APFT Cycles Before Birth	-0.576 (0.956)	0.767 (1.696)	-0.106 (1.074)	0.011 (1.303)
2 APFT Cycles Before Birth	(base)	(base)	(base)	(base)
1 APFT Cycle Before Birth	-3.192** (1.011)	0.098 (2.859)	-0.146 (1.153)	-3.223 (1.904)
APFT Cycle at Birth	-6.317*** (1.083)	(omitted)	-2.819* (1.263)	(omitted)
1 APFT Cycle After Birth	-3.681** (1.163)	-22.968*** (2.909)	-1.229 (1.332)	-18.350*** (2.008)
2 APFT Cycles After Birth	-1.663* (1.309)	-9.730**** (2.397)	-0.801 (1.531)	-12.288*** (2.160)
3 APFT Cycles After Birth	-1.179 (1.449)	-7.438** (2.719)	0.323 (1.698)	-8.847*** (2.093)
4 APFT Cycles After Birth	-0.427 (1.571)	-6.481 (3.313)	-0.093 (1.861)	-8.417*** (2.355)
5 APFT Cycles After Birth	1.606 (1.651)	-3.648 (3.303)	1.493 (1.876)	-9.433*** (2.559)
6 APFT Cycles After Birth	2.154 (1.878)	-0.905 (3.787)	1.332 (2.014)	-8.798** (2.973)
7 APFT Cycles After Birth	4.735* (1.905)	-0.572 (6.126)	1.711 (2.542)	-9.235* (3.770)
8+ APFT Cycles After Birth	2.796 (2.179)	-0.678 (5.363)	1.027 (2.745)	-4.754 (4.454)
Age				
17	(base)	(base)		
18	42.000*** (0.000)	34.192 (39.983)		
19	44.639*** (1.670)	37.042 (40.058)		
20	43.565*** (1.763)	36.968 (40.055)		

Army PFT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
21	38.975*** (1.814)	38.004 (40.069)	(base)	(base)
22	38.041*** (1.856)	39.870 (40.078)	10.883 (13.820)	-6.953 (7.292)
23	36.252*** (1.910)	38.307 (40.086)	10.739 (13.949)	-10.136 (7.566)
24	33.149*** (1.972)	40.091 (40.099)	8.889 (13.897)	-11.688 (7.556)
25	30.645*** (2.035)	39.758 (40.108)	5.369 (13.923)	-11.855 (7.502)
26	28.124*** (2.104)	38.933 (40.118)	2.220 (13.951)	-13.607 (7.573)
27	28.295*** (2.181)	39.978 (40.127)	2.386 (13.963)	-13.373 (7.607)
28	26.596*** (2.242)	38.561 (40.137)	1.826 (13.983)	-12.117 (7.640)
29	23.832*** (2.332)	38.006 (40.149)	0.984 (14.004)	-11.762 (7.683)
30	21.655*** (2.424)	35.199 (40.163)	-0.564 (14.030)	-11.716 (7.714)
31	20.842*** (2.509)	34.785 (40.183)	-0.858 (14.061)	-12.495 (7.754)
32	25.304*** (2.594)	42.888 (40.189)	3.394 (14.086)	-2.948 (7.783)
33	24.409*** (2.684)	43.800 (40.205)	4.003 (14.109)	-1.587 (7.854)
34	21.679*** (2.820)	41.358 (40.218)	3.263 (14.144)	-1.857 (7.892)
35	20.703*** (2.906)	38.258 (40.230)	3.166 (14.171)	-3.891 (7.959)
36	18.401*** (2.996)	36.094 (40.247)	1.047 (14.201)	-2.897 (8.026)
37	20.517*** (3.085)	42.993 (40.256)	4.030 (14.223)	5.297 (8.148)
38	18.806*** (3.196)	42.391 (40.278)	3.360 (14.249)	6.390 (8.278)
39	17.064*** (3.267)	36.932 (40.308)	0.469 (14.296)	5.523 (8.271)
40	13.628*** (3.413)	30.087 (40.350)	0.328 (14.308)	5.091 (8.322)
41	10.111*** (3.557)	30.279 (40.424)	-2.577 (14.328)	4.260 (8.359)
42	16.400*** (3.660)	37.427 (40.428)	3.248 (14.346)	8.903 (8.399)
43	14.356*** (3.750)	35.327 (40.458)	(3.475 (14.354)	9.422 (8.454)
44	11.052** (3.803)	30.158 (40.524)	1.314 (14.373)	7.233 (8.524)
45	7.884* (3.953)	26.128 (40.659)	-(0.673 (14.389)	6.310 (8.543)

Army PFT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
46	4.968 (4.110)	28.802 (40.737)	-1.463 (14.411)	5.940 (8.579)
47	9.500* (4.415)	30.437 (40.786)	5.169 (14.434)	8.011 (8.629)
48	8.545 (4.504)	25.939 (40.818)	5.042 (14.450)	8.000 (8.698)
49	8.798 (4.790)	19.583 (40.925)	4.155 (14.464)	4.298 (8.767)
50	5.852 (5.598)	20.045 (41.065)	1.471 (14.489)	0.658 (9.083)
51	3.752 (5.503)		1.596 (14.511)	
52	-4.094 (6.887)		0.565 (14.555)	
53	4.107 (6.706)		3.096 (14.665)	
54	6.864 (7.054)		1.700 (14.839)	
55	17.442* (8.885)		-2.562 (14.823)	
Constant	213.722*** (1.957)	209.952*** (40.072)	251.820*** (14.089)	265.371*** (7.695)
N	87021	28621	33481	20173
R-Squared	0.778	0.799	0.856	0.865
Adj R-Squared	0.691	0.713	0.812	0.819

Standard Error noted in parentheses.

*Significant differences from baseline at $p<0.05$

**Significant differences from baseline at $p<0.01$

***Significant differences between control and new parent group at $p<0.001$
Data retrieved from PDE system, August 2020-March 2021.

Table 4. Navy PRT Results by Male/Female and Officer/Enlisted Medical Personnel

Navy PRT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
PRT Score				
8+ PFA Cycles Before Birth	-5.979** (2.227)	-7.805* (3.870)	-8.122** (3.016)	-3.251 (2.778))
7 PFA Cycles Before Birth	-3.536 (2.105)	-3.490 (3.103)	-8.093** (2.912)	-3.721 (2.565)
6 PFA Cycles Before Birth	-2.778 (1.845)	-2.767 (2.819)	-4.128 (2.422)	-2.851 (2.281)
5 PFA Cycles Before Birth	-1.575 (1.520)	0.999 (2.358)	-1.621 (2.030)	-4.773* (2.134)
4 PFA Cycles Before Birth	0.446 (1.294)	-0.933 (1.952)	-0.292 (1.752)	0.395 (1.591)
3 PFA Cycles Before Birth	1.163 (1.120)	1.557 (1.831)	-0.319 (1.685)	-0.464 (1.622)
2 PFA Cycles Before Birth	(base)	(base)	(base)	(base)
1 PFA Cycle Before Birth	-2.262* (1.053)	-1.841 (2.579)	0.504 (1.565)	0.695 (2.562)
PFA Cycle at Birth	-3.777** (1.182)	(omitted)	0.039 (1.756)	(omitted)
1 PFA Cycle After Birth	-2.806* (1.301)	-14.950* (6.603)	-1.174 (1.911)	-14.404** (4.904)
2 PFA Cycles After Birth	-1.793 (1.412)	-15.177*** (3.337)	-3.220 (2.049)	-9.018** (2.901)
3 PFA Cycles After Birth	0.755 (1.520)	-9.459** (3.182)	0.996 (2.067)	-7.597* (3.083)
4 PFA Cycles After Birth	2.070 (1.617)	-6.176 (3.448)	0.635 (2.339)	-6.854 (4.188)
5 PFA Cycles After Birth	1.604 (1.777)	-1.121 (3.421)	2.619 (2.630)	-8.798 (4.653)
6 PFA Cycles After Birth	3.588 (1.860)	-2.085 (4.423)	5.715 (2.802)	-2.732 (3.969)
7 PFA Cycles After Birth	3.296 (2.081)	-1.407 (4.875)	7.102 (3.042)	-0.221 (4.587)
8+ PFA Cycles After Birth	4.696* (2.127)	-2.361 (6.073)	11.106*** (3.124)	-5.454 (4.808)
Age				
17	(base)			
18	18.845*** (2.171)	(base)		
19	24.779*** (2.005)	3.135 (2.019)		
20	42.466*** (1.989)	19.543*** (2.091)		

Navy PRT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
21	47.363*** (2.008)	23.905*** (2.166)	(base)	(base)
22	49.748*** (2.048)	26.236*** (2.233)	-12.007*** (2.183)	9.011 (11.778)
23	51.293*** (2.069)	28. 213*** (2.264)	-9.821*** (2.458)	12.461 (11.609)
24	52.386*** (2.092)	30.196*** (2.335)	-8.946*** (2.336)	14.825 (11.649)
25	61.807*** (2.109)	37.730*** (2.412)	5.055 (2.943)	22.707 (11.673)
26	64.300*** (2.121)	39.723*** (2.469)	9.044** (3.179)	24.260* (11.709)
27	65.617*** (2.140)	41.276*** (2.527)	13.072*** (3.258)	28.991* (11.724)
28	67. 295*** (2.158)	42.997*** (2.578)	17.045*** (3.327)	32.326** (11.744)
29	68.555*** (2.173)	43.658*** (2.655)	19.907*** (3.383)	35.303** (11.760)
30	76.897*** (2.190)	48.972*** (2.704)	28.254*** (3.431)	42.384*** (11.775)
31	79.042*** (2.209)	50.608*** (2.790)	30.555*** (3.473)	44.312*** (11.790)
32	80.213*** (2.231)	51.735*** (2.808)	32.683*** (3.508)	46.743*** (11.809)
33	80.550*** (2.245)	52.238*** (2.902)	34.490*** (3.545)	48.785*** (11.829)
34	82.470*** (2.261)	53.399*** (2.943)	36.696*** (3.580)	51.169*** (11.843)
35	87.574*** (2.284)	57.008*** (3.008)	44.038*** (3.610)	57.113*** (11.860)
36	88.846*** (2.308)	57.752*** (3.100)	47.120*** (3.638)	60.515*** (11.865)
37	88.435*** (2.330)	60.160*** (3.182)	49.016*** (3.664)	60.905*** (11.879)
38	88.868*** (2.365)	60.976*** (3.279)	51.301*** (3.684)	61.885*** (11.891)
39	88.010*** (2.409)	60.506*** (3.382)	52.141*** (3.707)	62.127*** (11.902)
40	92.686*** (2.450)	62.634*** (3.511)	58.705*** (3.720)	67.516*** (11.915)
41	92.996*** (2.494)	61.724*** (3.669)	60.672*** (3.745)	69.338*** (11.928)
42	92.113*** (2.547)	62.119*** (3.807)	62.492*** (3.760)	70.336*** (11.941)
43	91.448*** (2.635)	63.095*** (3.861)	64.502*** (3.780)	72.781*** (11.958)
44	91.754*** (2.707)	63.226*** (4.122)	65.011*** (3.801)	73.401*** (11.979)
45	98.143*** (2.803)	67.725*** (4.553)	71.564*** (3.818)	78.512*** (11.997)

Navy PRT Results by Male/Female and Officer/Enlisted				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
46	99.213*** (2.924)	70.786*** (4.977)	74.448*** (3.841)	79.909*** (12.003)
47			74.918*** (3.880)	80.291*** (12.030)
48			75.900*** (3.901)	
49			76.651*** (3.930)	
50			83.020*** (3.976)	
51			85.779*** (4.030)	
52			87.128*** (4.090)	
53			88.366*** (4.126)	
54			90.524*** (4.171)	
55			99.598*** (4.289)	
56			103.234*** (4.374)	
Constant	152.280*** (2.090)	178.045*** (2.253)	175.478*** (3.531)	181.151*** (11.765)
N	189103	47719	60117	31164
R-Squared	0.733	0.719	0.815	0.823
Adj R-Squared	0.683	0.652	0.786	0.789

Standard Error noted in parentheses.

*Significant differences from baseline at p<0.05

**Significant differences from baseline at p<0.01
***Significant differences between control and new parent group at p<0.001
Data retrieved from PDE system, August 2020-March 2021.

Table 5. Navy BMI Measurement by Male/Female and Enlisted/Officer Medical Personnel

Navy BMI Measurement by Male/Female and Enlisted/Officer				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
BMI Measurement				
8+ PFA Cycles Before Birth	0.197 (0.107)	0.083 (0.344)	-0.021 (0.119)	-0.263 (0.302)
7 PFA Cycles Before Birth	0.222* (0.095)	-0.055 (0.254)	-0.029 (0.107)	-0.288 (0.225)
6 PFA Cycles Before Birth	0.156 (0.085)	-0.132 (0.209)	-0.086 (0.094)	-0.379 (0.256)
5 PFA Cycles Before Birth	0.087 (0.075)	-0.148 (0.199)	-0.069 (0.106)	-0.193 (0.245)
4 PFA Cycles Before Birth	-0.003 (0.064)	-0.167 (0.167)	-0.037 (0.078)	-0.185 (0.196)
3 PFA Cycles Before Birth	-0.044 (0.053)	-0.107 (0.146)	-0.061 (0.065)	-0.005 (0.141)
2 PFA Cycles Before Birth	(base)	(base)	(base)	(base)
1 PFA Cycle Before Birth	-0.003 (0.051)	-0.138 (0.350)	0.025 (0.065)	-0.185 (0.206)
PFA Cycle at Birth	0.053 (0.058)	(omitted)	0.100 (0.078)	(omitted)
1 PFA Cycle After Birth	-0.218*** (0.066)	0.119 (0.191)	0.066 (0.086)	0.082 (0.179)
2 PFA Cycles After Birth	-0.422*** (0.069)	-0.092 (0.183)	-0.040 (0.098)	-0.038 (0.167)
3 PFA Cycles After Birth	-0.452*** (0.078)	-0.168 (0.195)	-0.062 (0.105)	-0.049 (0.170)
4 PFA Cycles After Birth	-0.677*** (0.089)	-0.165 (0.204)	-0.037 (0.118)	-0.053 (0.170)
5 PFA Cycles After Birth	-0.741*** (0.100)	-0.274 (0.220)	-0.101 (0.135)	-0.152 (0.179)
6 PFA Cycles After Birth	-0.681*** (0.111)	-0.361 (0.233)	-0.143 (0.154)	-0.143 (0.191)
7 PFA Cycles After Birth	-0.824*** (0.123)	-0.438 (0.259)	-0.206 (0.156)	-0.121 (0.199)
8+ PFA Cycles After Birth	-0.846*** (0.156)	-0.640 (0.335)	-0.233 (0.157)	-0.094 (0.213)
Age				
17	(base)			
18	1.706*** (0.135)	(base)		
19	2.240*** (0.127)	0.549*** (0.102)		
20	2.911*** (0.127)	1.199*** (0.115)		(base)
21	3.604*** (0.129)	1.801*** (0.122)	(base)	0.489*** (0.144)
22	4.182*** (0.131)	2.352*** (0.128)	-0.529 (0.341)	0.380*** (0.066)

Navy BMI Measurement by Male/Female and Enlisted/Officer				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
23	4.670*** (0.132)	2.882*** (0.132)	-0.420 (0.347)	0.452*** (0.054)
24	5.130*** (0.133)	3.326*** (0.137)	-0.102 (0.357)	0.572*** (0.050)
25	5.578*** (0.134)	3.826*** (0.142)	0.002 (0.376)	0.810*** (0.059)
26	5.989*** (0.135)	4.282*** (0.148)	0.262 (0.373)	1.010*** (0.079)
27	6.365*** (0.136)	4.738*** (0.153)	0.444 (0.376)	1.176*** (0.085)
28	6.718*** (0.137)	5.120*** (0.157)	0.641 (0.377)	1.338*** (0.093)
29	7.016*** (0.138)	5.486*** (0.162)	0.750* (0.378)	1.522*** (0.098)
30	7.355*** (0.139)	5.980*** (0.167)	0.918* (0.379)	1.736*** (0.105)
31	7.645*** (0.140)	6.376*** (0.171)	1.067** (0.380)	1.912*** (0.111)
32	7.948*** (0.141)	6.862*** (0.177)	1.180** (0.381)	2.061*** (0.115)
33	8.240*** (0.142)	7.231*** (0.181)	1.361*** (0.382)	2.312*** (0.120)
34	8.514*** (0.143)	7.671*** (0.186)	1.464*** (0.383)	2.534*** (0.126)
35	8.779*** (0.144)	8.038*** (0.190)	1.563*** (0.383)	2.800*** (0.130)
36	9.043*** (0.145)	8.452*** (0.199)	1.741*** (0.384)	2.974*** (0.134)
37	9.341*** (0.146)	8.830*** (0.203)	1.847*** (0.385)	3.294*** (0.140)
38	9.609*** (0.147)	9.200*** (0.214)	2.004*** (0.385)	3.548*** (0.146)
39	9.875*** (0.149)	9.665*** (0.221)	2.085*** (0.386)	3.780*** (0.151)
40	10.148*** (0.151)	10.098*** (0.225)	2.285*** (0.386)	4.222*** (0.157)
41	10.432*** (0.153)	10.577*** (0.239)	2.509*** (0.387)	4.458*** (0.160)
42	10.739*** (0.156)	10.900*** (0.249)	2.680*** (0.387)	4.732*** (0.165)
43	11.006*** (0.160)	11.477*** (0.269)	2.882*** (0.387)	5.026*** (0.172)
44	11.205*** (0.165)	11.666*** (0.281)	3.027*** (0.388)	5.175*** (0.175)
45	11.338*** (0.176)		3.155*** (0.389)	
46	11.615*** (0.180)		3.308*** (0.389)	
47	11.740*** (0.191)		3.450*** (0.390)	

Navy BMI Measurement by Male/Female and Enlisted/Officer				
Variable	Male Enlisted	Female Enlisted	Male Officer	Female Officer
48	11.930*** (0.203)		3.591*** (0.391)	
49	12.276*** (0.211)		3.718*** (0.391)	
50	12.395*** (0.227)		3.841*** (0.392)	
Constant	20.657*** (0.134)	21.015*** (0.134)	24.423*** (0.381)	21.569*** (0.102)
N	221320	57214	63034	33434
R-Squared	0.905	0.877	0.917	0.908
Adj R-Squared	0.890	0.853	0.906	0.892

Standard Error noted in parentheses.

*Significant differences from baseline at p<0.05

**Significant differences from baseline at p<0.01

***Significant differences between control and new parent group at p<0.001
Data retrieved from PDE system, August 2020-March 2021.

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