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Risky Fitness: Does Fitness Level at Entry Impact Length of Service?

March 2024

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

ACQUISITION RESEARCH PROGRAM
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NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

Achieving recruiting targets is a key issue for all services in the Australian Defence Force, and the Australian Army is considering lowering fitness standards to confront this challenge. This thesis evaluates the effects of fitness on initial training success and length of service in the Australian Army. Using individual data on Officers and Soldiers from 2003 to 2023, I categorize Australian Army applicants into fitness groups based on their Pre-enlistment Fitness Assessment results. Logistic regressions show that Officers with a low fitness level are 1.12 times more likely to fail to complete initial training compared to Officers with a high level of fitness, and Soldiers with a low fitness level are 1.23 times more likely than Soldiers with a high level of fitness. Comparing low to high fitness levels I find a significant reduction in retention for Officers (10% fewer) and Soldiers (20% fewer) after six years of service. These findings have important implications for the Australian Army as they consider lowering physical fitness standards to boost recruiting numbers. My survival analysis shows that fitness is crucially important for maximizing retention in the Australian Army, while highlighting the effectiveness of innovative recruiting programs such as the Army Pre-Conditioning Program.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADFA	Australian Defence Force Academy
FSPC	Future Soldier Preparatory Course
PFA	Pre-enlistment Fitness Assessment
ADF	Australian Defence Force
APCP	Army Pre-Conditioning Program
USMC	United States Marine Corps
ARMS	Assessment of Recruit Motivation and Strength

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I. INTRODUCTION

In March 2022, Prime Minister Scott Morrison (2022) announced that the Australian Defence Force (ADF) would grow its workforce by 30% by the year 2040, the largest increase since World War II. This necessitates a significant transformation of ADF recruitment and retention strategies. However, the ADF is currently struggling to meet its recruitment targets, exacerbated by a rebounding Australian job market after COVID-19.

The Australian Army, the largest Service in the ADF, faces arguably the largest challenge. According to the Department of Defence Annual Report 21/22 the Australian Army will need to grow by 9,500 individuals between 2023 and 2040 (Department of Defence, 2022). Yet in financial year 2022, much like the United States Army, the Australian Army missed its' recruiting target by nearly 20%.

According to the Directorate of Workforce Planning (2022), the mean growth of the Australian Defence Force has been close to 300 troops annually, but the current projection requires a growth rate nearly three and a half times faster. This challenge must be managed alongside growing attrition rates, notably due to medical separations from injuries sustained during initial training and through on-going service. While entry requirements vary across Army roles, minimum fitness standards remain consistent. Reducing these standards could increase recruitment numbers but risks higher injury rates during training. Before enacting changes to boost recruit numbers, it is important for the Australian Army to understand their effects on completing initial military training and overall length of service. This thesis aims to analyze the effects of pre-enlistment fitness on both completion of initial training and on the length of service each individual completes.

As a means of boosting recruiting numbers, the Australian Army introduced the Army Pre-Conditioning Program (APCP) in 2016, which provides additional training for applicants just below fitness standards (Australian Department of Defence, 2023). While early recruitment numbers through the APCP have been promising, this thesis seeks to analyze the longer-term impact for these individuals.

Using individual data from January 2003 to January 2023 on Officer and Soldier Pre-enlistment Fitness Assessment (PFA) results and the resultant periods of service by those individuals, this thesis seeks to analyze the impact of fitness level at recruitment. This study asks three main research questions. First, how does fitness level at entry impact initial training completion? Second, does fitness level at entry impact length of service in the Australian Army? And finally, does the Army Pre-Conditioning Program impact length of service?

Current research into risk of injury during military training identifies fitness level is negatively correlated to an individuals' risk of injury. It also suggests that this risk increases as military training progresses and that those members injured during training record lower fitness levels for the remainder of their career. While there are many studies into the link between fitness and injury risk during military training, further analysis into long-term service implications is lacking. My thesis aims to investigate this further by examining the relationship between initial fitness levels, training completion, and length of service.

This study uses data from 13,514 unique individuals who joined the Army between 2003 and 2023, separated into Officers and Soldiers due to the significant difference in initial training between the two groups. Individuals who participated in the APCP are classified into the APCP group. The remaining individuals are classified into a fitness group (Low, Medium or High) based on their standardized PFA result. The process for generating the standardized PFA score is detailed in Chapter IV.

Logistic regression analysis shows that Officers in the Low fitness group were 1.12 times more likely to fail initial training than Officers in the High fitness group, while Soldiers in the Low fitness group were 1.23 times more likely to fail initial training than Soldiers in the High fitness group. Both results were found to be highly statistically significant (p-value<0.01).

Kaplan-Meier survival analysis shows the survival rate for Officers in the Low group was 10% lower at the six-year mark than Officers in the Medium or High group. The

effect for Soldiers was more pronounced, with Soldiers in the Low group recording 20% lower at the six-year mark than Soldiers in the High group.

The results from this study show that a Low fitness level at entry has a negative impact on both training completion and survival rate. This suggests that any decision to lower minimum fitness standards to boost recruiting numbers will bring with it an increased risk of injury during initial training and reduction of the length of service for these individuals.

Chapter II will detail the current research into risk of injury during military training as well as different programs that the Australian and United States militaries have implemented to increase the fitness level of trainees that sit just below the minimum standards for entry. Chapter III provides a background on service in the Australian Army including detail on the conduct of the Pre-enlistment Fitness Assessment and the delivery of the Army Pre-Conditioning Program. Chapter IV describes the data used in this study as well as the methodology for the analysis. Chapter V reports the results of my analysis and Chapter VI discusses the implications of these results and recommendations for the Australian Army.

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II. LITERATURE REVIEW

This chapter examines fitness requirements of modern militaries, with a particular focus on the Australian Army. It details the key research projects conducted at the Australian Army's initial training units and compares them to research from the United States Marine Corps and United States Army.

A. INJURY RISK DURING INITIAL TRAINING

Rudzki (1999) analyzed the correlation between fitness level, measured by the 20-meter beep test, and successful completion of initial military training in the Australian Army. Based on individual data from 1,952 recruits in 1996/97, he found low levels of past activity and low levels of physical fitness were significant risk factors for injury during initial training. Thus, new recruits with lower fitness levels are probably at a greater risk of injury during initial training. This research led to the implementation of minimum fitness standards for entry, detailed in Table 1, which aim to reduce the number of training failures due to injury. Rudzki's research also investigated the likely cause of common injuries during initial training finding lower limb injuries were more prevalent in individuals with lower fitness levels, and as a result the Australian Army modified the physical fitness training program for recruits by reducing the amount of long distance running and eliminating running in combat boots.

Rudzki's (1999) research also addressed gender differences in injury rates, highlighting the importance of equitable fitness standards. He found that although females were reported to have a higher injury rate overall, when he controlled for fitness level, they had the same injury rate as males. This research went on to conclude that the increased risk of injury was due to a lower average fitness level for female recruits, which suggests that we need to control for gender when analyzing fitness levels. Rudzki's (1999) research led to different push up entry standards for men and women, to ensure women weren't disadvantaged by the strength requirement of this test. Men are required to complete 15 push-ups and women 8 push-ups, while all applicants must complete a minimum of 45 sit-ups and reach a 7.5 on the beep test, shown in Table 1.

Table 1. Pre-enlistment Fitness Assessment (PFA) minimum standards. Source: Defence Force Recruiting (2024).

	Push Ups	Sit Ups	Beep Test
Males	15	45	7.5
Females	8	45	7.5

Schram et al. (2019) found that approximately 23% of trainees are injured during Australian Army basic training each year (1,385 of 6,082 recruits over the period 2012–2014). They also found that the injury rates in the Australian Army are very similar to those observed in the United States, Greek and Maltese Army's. This suggests that if the 23% injury rate is considered normal for Army basic training, to reduce the injury rate, we must either improve the physical readiness of trainees prior to enlistment or change the way we train.

Booth et al. (2006) investigated the symptoms of overtraining during Australian Army training and found that while recruits increase their strength during training, the repetitive nature of training results in a decrease in aerobic endurance. The elevated levels of physical fatigue can increase an individual's risk of injury and they concluded that it is advantageous to enter initial training with a higher level of fitness. Highlighting the reduction in aerobic endurance later in basic training is important, as it shows that the injury risk rate is not constant. While recruits with lower fitness levels may survive the early phases of training, their risk of failure due to injury increases later in training.

Jensen et al. (2019) studied musculoskeletal injuries in the United States Marine Corps (USMC) training. Using data on 28,829 USMC recruits attending basic training between 2011 and 2016, they found that 14% of recruits are injured at some point during basic training. Those injured reported a reduction in fitness level for the remainder of their training. More concerning was that injured Marines also continued to achieve lower fitness test results later into their careers. This suggests that the risk of an individual separating due to injury is not limited to initial training but increases their likelihood of separating throughout their career. While their study focused on musculoskeletal injuries and recruits

training for combat roles, it suggests broader implications for fitness standards in the military.

B. PROGRAMS AIMED AT BOOSTING RECRUITING NUMBERS

While the ADF can make every effort to increase the fitness level of potential recruits once they start their application process, the average recruit will likely reflect the general fitness and physical activity level of the general public.

Reports from the Australian Sports Commission (2023) show declining physical activity among the Australian public, particularly in the Army's target recruiting age group of 18–24 year olds. For example, the share of adults who exercise three or more times per week, a common benchmark used by Defence Force Recruiting interviewers, has dropped by 2.6 percentage points since its peak of 63.7% in 2019. This is contributing to the reduction in applicants being able to meet the Army's current minimum standards, while putting them at greater risk of injury when they ramp up their physical conditioning activities during military training. Merlo et al. (2019) found even more dramatic changes amongst United States adolescents, concluding that the number of high school students who met the United States Department of Health and Human Services recommended physical activity guidelines had reduced 5.5 percentage points, from 28.7% in 2011 down to 23.2% in 2019.

In 2022, the United States Army trialed the Future Soldier Preparatory Course (FSPC) which, much like the Australian Army's APCP, sought to improve fitness and academic levels of recruits prior to commencing basic training (Barno & Bensahel, 2023). Recruits trained for up to 90 days, with an opportunity to leave the program every three weeks if they meet or exceed the Army's desired accession standards. After 92% of the almost 3,000 participants graduated from the trial, the United States Army expanded the program in 2023.

The FSPC was not the first attempt to boost recruiting success using a different approach to improve fitness levels. Loughran and Orvis (2011) explored the effectiveness of the United States Army Assessment of Recruit Motivation and Strength (ARMS) test, which provides a different way of assessing an individual's physical ability. The ARMS

test comprises of a box step up assessment to test aerobic fitness and motivation along with a push up assessment to test muscular endurance. They found that males and females that failed to meet the weight and body-fat standards for entry but were able to pass the ARMS test, had a similar or sometimes lower attrition rate than those who met the weight and body-fat standards. This suggests that the more important consideration for recruitment should be the physical ability to meet the demands of their training rather than body composition standards. While my research does not extend to weight or body-fat standards, the link between overweight individuals and lower fitness levels is noted in much of the related literature detailed in this chapter.

C. SUMMARY

The current knowledge base only assesses the link between fitness and injury risk during military training but more research into long-term service implications is required. My thesis aims to investigate this further by examining the relationship between initial fitness levels, training completion, and length of service.

One of the key findings from Jensen et al. (2019) was that 95% of those with the lowest fitness levels at the commencement of basic training were likely to remain uninjured during training. This suggests that while the injury risk may increase, it may still be within an acceptable range. This has led me to conduct survival analysis to determine how different fitness levels impact the longer-term risk of discharge. Any differences will be important for the restructuring of retention initiatives.

Military branches from around the world have introduced programs to help increase recruits' fitness. These programs have shown positive results through their completion rates; however, these individuals have not been tracked beyond completion of initial training. To address this gap, my thesis will analyze APCP participation in the Australian Army, to determine the effect on the length of service for these individuals.

III. BACKGROUND

This chapter provides an overview of the Australian Army, the conduct of the Pre-enlistment Fitness Assessment (PFA), the structure and purpose of the Army Pre-Conditioning Program (APCP), and the various factors influencing members' decisions to separate from the Army.

A. AUSTRALIAN ARMY

The Australian Army has delivered training to recruits since its inception in 1901. The organization has continually evolved its recruiting procedures, including periods of conscription, but has always prioritized physical screening to mitigate injury during initial training, and thereby minimize any impacts on an individuals' resultant service.

The life of a soldier has always been inherently physical. Although the physical demands of soldiering have evolved with technological advancements, the need to maintain superiority on the battlefield drives commanders to ensure their forces are fit and capable of achieving their mission in a range of environments. Different physical standards for various roles and genders are set to enhance combat effectiveness while increasing diversity in the force. With this in mind, segregating data by gender in my analysis ensures a fair comparison of individuals' fitness levels to entry standards, preventing skewed conclusions.

B. FITNESS ASSESSMENT COMPONENTS

Introduced nearly 25 years ago, the Pre-enlistment Fitness Assessment (PFA) comprises push-ups, sit-ups, and a beep test (or shuttle run). Applicants must complete as many push-ups as possible in two minutes and maintain a prescribed cadence for sit-ups. Finally, the beep test is a continuous set of 20-meter shuttle runs where individuals must complete each shuttle before the next beep sounds. The period between beeps is reduced regularly and individuals continue until they cannot keep up with the cadence. The beep test scoring system is shown in Appendix A. For entry into the Army, men are required to

complete 15 push-ups and women 8 push-ups, while all applicants must complete a minimum of 45 sit-ups and reach a 7.5 on the beep test.

C. ARMY PRE-CONDITIONING PROGRAM

In 2016, the Australian Army introduced the Army Pre-Conditioning Program (APCP) in response to an increasing number of applicants failing to reach the minimum fitness standards for entry. The APCP offers applicants that have met all other criteria for entry other than fitness a seven-week fitness and resilience program at the same barracks that delivers initial training. The first six weeks focus on building fitness and physical conditioning through daily physical training sessions, while also delivering the skills covered in the first two weeks of initial training. The final week consists of an adventure training exercise that continues to deliver physical and mental resilience training. Participants then enter week three of the Army Initial Military Training course. To date the Army has graduated 366 trainees from the APCP.

D. LINKS BETWEEN FITNESS AND DISCHARGE

Injury is not the sole reason for trainees with lower fitness levels to discharge during training or throughout their careers. As an "all-volunteer force," soldiers may choose to discharge at any time. The shock of initial training and the demanding nature of soldiering, both physically and mentally, requires individuals to maintain motivation to operate at the required level. Joining the military is also often the first time individuals move away from home and the separation from their support network can be hard for both new trainees undergoing training, and for Officers and Soldiers as they progress through their careers. Individuals also experience periods of limited communication with their family and friends, particularly during military exercises and deployments, which can be difficult for both the members and their families. Rather than analyzing the various reasons that lead to discharge, this study focuses on whether initial fitness levels impact separation.

E. CONCLUSION

In recognition of the physical and mental stressors of service, the Army uses the PFA as one of the tools to assess an applicant's readiness for initial training and suitability

for on-going service. In this study I use the results of the PFA to categorize individuals to investigate its value in predicting attrition. To ensure applicants become effective Officers and Soldiers the Army offers programs such as the APCP as well as an emphasis on leadership and teamwork to ensure every member is prepared for the rigors of service and has the support they need to continue to serve. This study seeks to determine the effectiveness of the APCP by comparing the length of service of participants against non-participants.

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IV. DATA AND METHODOLOGY

In this Chapter I describe the two primary data sources provided by the Australian Defence Force (ADF) and outline the methodology employed to analyze the impact of trainee fitness level on both the completion of initial training and length of service.

A. DATA

The ADF supplied data covering all individuals who applied to join the Australian Army and those who subsequently served from 2003 to 2023. Defence Force Recruiting (personal communication, September 28, 2023) provided applicant data, including Pre-enlistment Fitness Assessment (PFA) results, enlistment details such as path of entry (Officer or Soldier), and demographic information such as gender, age, and marital status at enlistment. The PFA data comprised 45,366 records from 24,097 applicants comprising push-up, sit-up and beep test scores. Many applicants attempt the PFA on multiple occasions which accounts for the additional records. The Defence People Group (personal communication, September 28, 2023) provided panel data from the ADF Human Resource Data Warehouse, consisting of 566,346 person-year observations from 79,067 individuals. This data set includes an indicator for Officer or Soldier, current rank, current occupation (such as Infantry, Transport, Medical, etc.), length of service (the number of days they have served in the Army) and discharge/separation date for those members who discharged from the Army. After merging these datasets, I identified 13,514 unique individuals who passed a PFA and joined the Army during the specified period.

This dataset contained numerous suspected data entry errors related to PFA results. For example, there were 892 observations with a PFA result marked as Pass despite one or more of the components (push-up, sit-up or beep test) being recorded with a zero result, or a result below the Army's standard for entry. This may have occurred for two reasons. First, when an applicant passes one or two components during their first attempt at the PFA and returns to a subsequent PFA only to complete the component they failed during their earlier attempt. When this occurs only the score for the component they re-attempted is recorded against their final PFA result. This approach is adopted when recruiting staff are

concerned about an applicant being injured while attempting a component they have already passed. The second possibility is when an applicant has either the Royal Australian Navy or Royal Australian Air Force as their first job preference and thus are recorded to have passed that respective services' PFA standard, despite falling short of the Army standard. I created a pass with missing indicator for individuals that received an overall pass despite missing one or more components of the test.

I classified individuals into three fitness groups based on their PFA result, labeled High, Medium, Low. The sit-up and beep test results were standardized independent of gender, reflective of the equivalent entry standards for these components. Due to the different push-up standard for males and females, individual push-up results were standardized by gender. Standardizing a component involves taking the score recorded by the individual and then subtracting the mean result for that component, and dividing it by the standard deviation.

$$\text{Standardized sit-ups} = \frac{\text{Individual sit-up score} - \text{Mean(all sit-up scores)}}{\text{Standard Deviation of sit-up scores}}$$

The standardized PFA score was calculated as the average of the three standardized component results. The top third of results were classified as the High fitness group, middle third as the Medium fitness group and lowest third as the Low fitness group. All individuals who participated in the APCP program were categorized into the APCP group, independent of their PFA result.

For example, a male Officer who completed 15 push-ups, 45 sit-ups and a 7.5 beep test score, would convert to a standardized push-up score of -0.56, a standardized sit-up score of -0.72 and a standardized beep test score of -0.86. The average of these three standardized component scores gives the standardized PFA score of -0.71. The range of standardized PFA scores for Officers in the Low fitness group ranges from -3.0 to -0.68, and thus the example Officer would be assigned to the Low fitness group.

Similarly, a female Soldier who completed 50 push-ups, 100 sit-ups and a 10.6 beep test score, would convert to a standardized push-up score of 2.14, a standardized sit-up score of 2.23 and a standardized beep test score of 4.63. The average of these three

standardized component scores gives the standardized PFA score of 3.00. The range of standardized PFA scores for Soldiers in the High fitness group ranges from 0.14 to 3.92, and thus the example Soldier would be assigned to the High fitness group.

I created an APCP indicator which equals 1 for all individuals who participated in the APCP program, independent of their PFA result, and 0 for non APCP participants.

Table 2 shows the descriptive statistics for the complete dataset, segregated by Officers and Soldiers.

Table 2. Descriptive statistics for Officers and Soldiers

	Officers			Soldiers		
Variable	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Fitness Group						
... Low		33.5%			34.1%	
... Med		32.5%			29.2%	
... High		33.8%			33.7%	
... APCP		0.2%			3%	
Female		36.7%			26.0%	
Age at enlist		22.1	5.73		21.6	5.26
Married at enlist		8.3%			8.7%	
Count	1,677			11,837		

Adapted from Defence Force Recruiting (personal communication, September 28, 2023) and Defence People Group (personal communication, September 28, 2023).

Key to the analysis was identifying Officers and Soldiers who separated from the Army, particularly those individuals who separated during their initial training period. Of those who separated, 197 Officers and 605 Soldiers failed to complete their initial military training course and thus separated from the Australian Army; these individuals are categorized as Training Failures. These were identified in the data as observations where separation occurred while the individual held the rank of Officer Cadet, Recruit or Trainee. Table 3 illustrates separation and training failure rates across fitness groups for Officers, with similar observations for Soldiers depicted in Table 4.

Table 3. Officer separation and initial training fail

Label	Variable	Has Separated from the Australian Army		test	Failed to Complete Initial Training		test
		1	0		1	0	
Fitness Group	Low	121 (46%)	457 (32%)	<0.0001	85 (43%)	493 (33%)	0.0064
	Med	88 (33%)	439 (31%)	0.4388	67 (34%)	460 (31%)	0.4054
	High	54 (21%)	515 (36%)	<0.0001	45 (23%)	524 (35%)	0.0005
	APCP	0 (0%)	3 (0.2%)	1	0 (0%)	3 (0.2%)	1

Adapted from Defence Force Recruiting (personal communication, September 28, 2023) and Defence People Group (personal communication, September 28, 2023).

Table 3 shows that Officers in the Low fitness group represented a larger percentage (46%) of those who separated, compared with the Medium (33%) or High (21%) groups. This suggests that Officers in the Low fitness group are over-represented in those Officers who separated from the Army. The difference between those who separated and those who remained in service for both the Low (46% vs. 32%) and High (21% vs. 36%) groups was found to be highly statistically significant.

This trend continues when focusing on training failures whereby Officers in the Low fitness group represented a larger percentage (43%) of those who failed to complete initial training, compared with the Medium (34%) or High (23%) groups. This suggests that Officers in the Low fitness group are over-represented in those Officers who failed to complete initial training. Again, the difference between those who failed to complete initial training and those who completed it for both the Low (43% vs. 33%) and High (23% vs. 35%) groups was found to be highly statistically significant.

Due to the Low number of Officers who participated in the APCP neither of these results were statistically significant, suggesting we cannot be confident that the APCP has any effect on whether Officers separate from the Army or fail to complete initial training.

Table 4. Soldier separation and initial training fail

Label	Variable	Has separated from the Australian Army		test	Failed to Complete Initial Training		test
		1	0		0	1	
Fitness Group	Low	2035 (59%)	2230 (27%)	<0.0001	293 (48%)	3972 (35%)	<0.0001
	Med	698 (20%)	2466 (39%)	<0.0001	152 (25%)	3012 (27%)	0.3596
	High	670 (19%)	3375 (40%)	<0.0001	140 (23%)	3905 (35%)	<0.0001
	APCP	39 (1%)	324 (4%)	<0.0001	20 (3%)	343 (3%)	0.7262

Adapted from Defence Force Recruiting (personal communication, September 28, 2023) and Defence People Group (personal communication, September 28, 2023).

Table 4 shows that Soldiers in the Low fitness group represented a larger percentage (59%) of those who separated, compared with the Medium (20%) or High (19%) groups. This suggests that Soldiers in the Low fitness group are over-represented in those Soldiers who separated from the Army. The difference between those who separated and those who remained in service for the Low (59% vs. 27%), Medium (20% vs. 39%) and High (19% vs. 40%) groups were all found to be highly statistically significant.

This trend continues when focusing on training failures whereby Soldiers in the Low fitness group represented a larger percentage (48%) of those who failed to complete initial training, compared with the Medium (25%) or High (23%) groups. This suggests that Soldiers in the Low fitness group are over-represented in those Soldiers who failed to complete initial training. Again, the difference between those who failed to complete initial training and those who completed it for both the Low (48% vs. 35%) and High (23% vs. 35%) groups was found to be highly statistically significant.

The larger number of Soldiers who participated in the APCP allows for better analysis of the differences for these individuals. Of the Soldiers who participated in the APCP, almost 90% (APCP separations/total APCP participants) continued to serve in the Army at the completion of the period of study. This result was found to be statistically

significant, suggesting the APCP has a positive effect on the longer-term survival of the participants.

Notably, lower fitness levels correlated with higher separation rates and increased likelihood of training failure. However, participation in the APCP showed a significant positive impact on Soldiers' longer-term retention. But these cross tabulations do not capture all the differences between individuals in each group. Regression analysis was then conducted to further elucidate the effect of entry fitness level on training outcomes, particularly failures. This method provides a more nuanced understanding of the relationship between fitness level and training success.

B. METHODOLOGY

I divided the analysis into two stages. Firstly, I used a logit model to predict the likelihood of completing initial training based on fitness level at entry. The dependent variable, training failure, takes on the value 1 for individuals who were separated from the Australian Army during their training phase; and 0 if they complete their initial training period. The logit regressions also control for individual factors such as gender, age at enlistment, married at enlistment, PFA pass with missing components, and enlistment cohort indicators to isolate their effects on training completion and ensure accurate assessment of fitness level impact.

The key independent variables in the logit regression are the binary indicators for each fitness group (Low, Medium, High, and APCP). The additional control variables are gender (1 for females, 0 for males), age at enlistment (in years), married at enlistment (1 for married, 0 for not married), PFA pass with missing components indicator (1 for failures to meet minimum standards, 0 for all components met), and cohort year indicators. Given the diverse reasons for Army separation, the analysis focused solely on training-related separations rather than specific causes.

In the second stage, Kaplan-Meier survival analysis was employed to assess differences in length of service based on entry fitness level. The dependent variable, service length, was recorded in two ways: overall cumulative service and current period of service. Overall cumulative service is the sum of all periods of service for an individual, which

includes periods of service that occurred outside of the timeframe for this study. The current period of service is the length of time between the enlistment date that is tied to the PFA results in my dataset and either an individual's separation date or the end of the study period. To ensure data integrity and avoid bias from prior service, only current period of service lengths was used for analysis, particularly for the 114 individuals with previous Army service.

The logit analysis results address the first research question; how does fitness level at entry impact initial training completion? Meanwhile, the Kaplan-Meier survival analysis addresses the second research question; does fitness level at entry impact length of service in the Australian Army? These findings are discussed further in the subsequent chapter.

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V. RESULTS

This chapter describes the results of logistic regressions estimating the probability of individuals failing to complete initial training, separated for both Officers and Soldiers. Additionally, I describe the findings of the Kaplan-Meier survival analysis conducted separately for Officers and Soldiers.

A. LOGISTIC REGRESSIONS

I estimated six regression models for both Officers and Soldiers, estimating the probability of training failure based on an individual's fitness level. Individuals with a standardized PFA score in the upper third were categorized into the High fitness group, those in the middle third into the Medium fitness group, and those in the bottom third were categorized into the Low fitness group. Since the outcome is an indicator variable, I used logistic regressions and report odds ratios in the tables below, beginning with the results for Officers in Table 5 and Soldiers in Table 6.

In column (1), I present results for the model predicting training failure probability using only the fitness groups. In column (2), I present results when adding a control for female to mitigate against gender biases. In column (3), I present results when adding a control for age at enlistment to mitigate bias related to age differences. In column (4), I present results when adding a control for marital status at enlistment to adjust for different completion rates between married and un-married individuals. In column (5), I present results when adding a control for individuals who recorded a pass on their PFA despite not meeting the Army's minimum entry standard, ensuring a more accurate reflection of fitness level at entry. Finally, column (6) introduces fixed effects for year of entry (cohort) to adjust for changes in public physical activity levels over time and differences in initial training course intensity across years. This ensures individuals are compared within similar training contexts. In all models the High fitness group is the reference category.

Table 5. Logistic regression results for Officers, in odds ratios

Analysis of Training Fail for Officers

	Dependent variable:					
	Training Fail					
	Fitness Group	+ Gender	+ Age	+ Married	+ Pass With Missing	+ Year of Enlistment
	(1)	(2)	(3)	(4)	(5)	(6)
Low	2.02***	2.01***	1.98***	1.99***	1.98***	1.12***
	(0.19)	(0.20)	(0.20)	(0.20)	(0.20)	(0.26)
Medium	1.71***	1.69***	1.68***	1.68***	1.68***	1.31***
	(0.20)	(0.21)	(0.21)	(0.21)	(0.21)	(0.22)
Female		1.05***	1.08***	1.08***	1.07***	1.05***
		(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Age at Enlist			0.96***	0.96***	0.96***	0.95***
			(0.02)	(0.02)	(0.02)	(0.02)
Married				0.93***	0.92***	1.02***
				(0.35)	(0.35)	(0.35)
Pass With Missing					1.29	1.65**
					(0.79)	(0.82)
Cohort Fixed Effects	N	N	N	N	N	Y
Observations	1,677	1,677	1,677	1,677	1,677	1,677
Log Likelihood	-599.69	-599.64	-595.88	-595.86	-595.81	-553.51
Akaike Inf. Crit.	1,205.37	1,207.29	1,201.76	1,203.72	1,205.62	1,139.02

Note: Standard errors in parentheses. The omitted category is High.
** p < 0.05; *** p < 0.01.

Table 5 shows a linear relationship between fitness level and probability of failing to complete training. Specifically, column (1) shows Officers in the Low and Medium fitness categories are 2.02 and 1.71 times more likely to fail training, respectively, compared to Officers in the High fitness group (reference group). The introduction of controls for gender in column (2), age in column (3), married in column (4), and pass with missing in column (5) does not significantly alter the odds ratio. The APCP group was excluded from the logistic regressions for Officers due to the small number of observations.

The most comprehensive model is presented in column (6), which includes controls for gender, age at enlistment, an indicator for married, an indicator for pass with missing as explained earlier, and fixed effects for cohort. Unlike columns (1) through (5), the odds

ratio in column (6) are smaller suggesting that it is important to compare individuals within the same entry cohort. They reveal that Officers in the Low and Medium fitness groups are 1.12 and 1.31 times more likely, respectively, to fail to complete initial training compared to those in the High fitness group.

The second model introduces a control for gender, indicating that female Officers have a marginally higher probability of separating during initial training. The third model introduces a control for age at enlistment, indicating a marginal effect suggesting that older Officers are slightly less likely to fail to complete training. The fourth model introduces a control for married, initially indicating a negative correlation, but the final model suggests that married Officers have a marginally higher probability of separating during initial training. The fifth model introduces a control for Officers who failed to pass at least one component of their PFA yet were recorded as passing the requirements and subsequently enlisted. This model suggests that Officers recorded as passing despite missing one or more components of the PFA were more likely to fail initial training.

Table 6. Logistic regression results for Soldiers, in odds ratios

Analysis of Training Fail for Soldiers

	Dependent variable:					
	Training Fail					
	Fitness Group	+ Gender	+ Age	+ Married	+ Pass With Missing	+ Year of Enlistment
	(1)	(2)	(3)	(4)	(5)	(6)
Low	2.06***	2.01***	2.01***	2.01***	2.05***	1.23***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.14)
Medium	1.41***	1.37***	1.37***	1.37***	1.38***	1.13***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
APCP	1.63***	1.37***	1.36***	1.38***	1.35***	1.71***
	(0.25)	(0.25)	(0.25)	(0.25)	(0.26)	(0.27)
Female		1.26***	1.26***	1.26***	1.29***	1.15***
		(0.09)	(0.09)	(0.09)	(0.10)	(0.10)
Age at Enlist			1.01***	1.01***	1.01***	1.01***
			(0.01)	(0.01)	(0.01)	(0.01)
Married				0.80***	0.80***	0.81***
				(0.17)	(0.17)	(0.17)
Pass With Missing					0.78***	2.08***
					(0.21)	(0.24)
Cohort Fixed Effects	N	N	N	N	N	Y
Observations	11,837	11,837	11,837	11,837	11,837	11,837
Log Likelihood	-2,362.94	-2,359.90	-2,359.66	-2,358.78	-2,358.07	-2,219.16
Akaike Inf. Crit.	4,733.88	4,729.80	4,731.31	4,731.55	4,732.14	4,486.33

Note: Standard errors in parentheses. The omitted category is High.
** p < 0.05; *** p < 0.01.

Table 6 shows a linear relationship between fitness level and probability of failing to complete training. Specifically, column (1) shows Soldiers who were in the Low and Medium fitness groups are 2.06 and 1.41 times more likely to fail training, respectively, compared to Soldiers in the High fitness group (reference group). The introduction of controls for gender in column (2), age in column (3), married in column (4), and pass with missing in column (5) does not significantly alter the odds ratio.

Soldiers in the APCP are 1.63 times more likely to fail training compared to Soldiers in the High fitness group in column (1). This decreases slightly to 1.37 after

controlling for gender but remains consistent across columns (3), (4) and (5) and remains statistically significant.

The most comprehensive model is presented in column (6), which includes controls for gender, age at enlistment, an indicator for married, an indicator for pass with missing as explained earlier, and fixed effects for cohort. Unlike columns (1) through (5), the odds ratio in column (6) are smaller suggesting that it is also important to compare individuals within the same entry cohort for Soldiers. They reveal that Soldiers in the Low and Medium fitness groups are 1.23 and 1.13 times more likely, respectively, to fail to complete initial training compared to those in the High fitness group. Finally, Soldiers who participated in the APCP are 1.71 times more likely to become training failures compared to those in the High fitness group. This aligns with expectations, as APCP participants require additional training to meet minimum standards and thus face a higher risk of failing initial training.

The second model introduces a control for gender, indicating that female Soldiers have a higher probability of separating during initial training. The third model introduces a control for age at enlistment, indicating a marginal effect suggesting that older Soldiers are slightly more likely to fail to complete training. The fourth model introduces a control for married, indicating that married Soldiers are less likely to separate during initial training. The fifth model introduces a control for Soldiers who failed to pass at least one component of their PFA yet were recorded as passing the requirements and subsequently enlisted. This model initially reports a negative correlation, but in the final model, it suggests that Soldiers recorded as passing despite missing one or more components of the PFA were more likely to fail initial training.

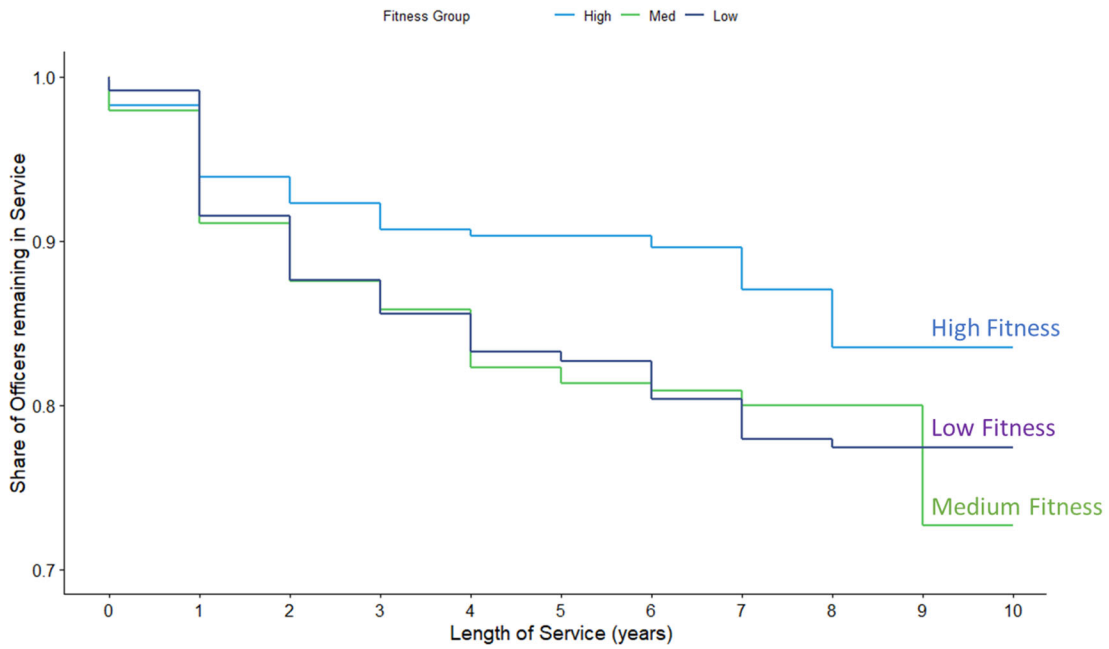
All models for both Officers and Soldiers were also run with a subset of the data that excluded observations missing one or more PFA components. The coefficients were not significantly different from those in the main models, likely due to the small relative number of observations missing a PFA component. The tables for these models are shown in Appendix B.

The regressions showed that both Officers and Soldiers in the Low fitness group had a higher likelihood of experiencing training failures compared to those in the High

fitness groups. The odds ratios of 1.12 and 1.23 for Officers and Soldiers, respectively, are statistically significant.

B. SURVIVAL ANALYSIS

Next, I use survival analysis to investigate whether length of service varies by fitness level, addressing my second research question: does fitness level at entry influence the length of service in the Australian Army? Using Kaplan-Meier survival analysis, I directly compare fitness groups based on length of service and an indicator for Army separation during the study period, visually displaying the proportion of Officers and Soldiers remaining in service after each year. This analysis is conducted on the full dataset, including individuals who failed to complete initial training. Figure 1 shows the survival curves for Officers and Figure 2 shows the curve for Soldiers.



The APCP group has been removed due to the low number of observations.

Figure 1. Kaplan-Meier survival rates for Officers

Figure 1 shows Officers in the High fitness group consistently maintain higher survival rates compared to the Low and Medium groups. Both the Low and Medium groups

exhibit consistent service levels throughout the study, indicating minimal differences in the length of service for Officers in these groups.

At the six-year mark, which aligns with the Initial Minimum Period of Service for Officers who enter training directly into the Royal Military College, nearly 90% of Officers in the High fitness group remain in service, while about 80% of Officers in the Low and Medium groups do so. This 10% difference translates to approximately 106 additional Officers.

At the nine-year mark, which aligns with the Initial Minimum Period of Service for Officers who enter training at the Australian Defence Force Academy (ADFA), nearly 85% of Officers in the High fitness group and 78% of Officers in the Low group remain in service. The most significant drop occurs in the Medium fitness group which shows a 7 percentage point drop from years eight to nine. Investigation of the data shows that the majority of this drop is attributed to Officers that attended ADFA.

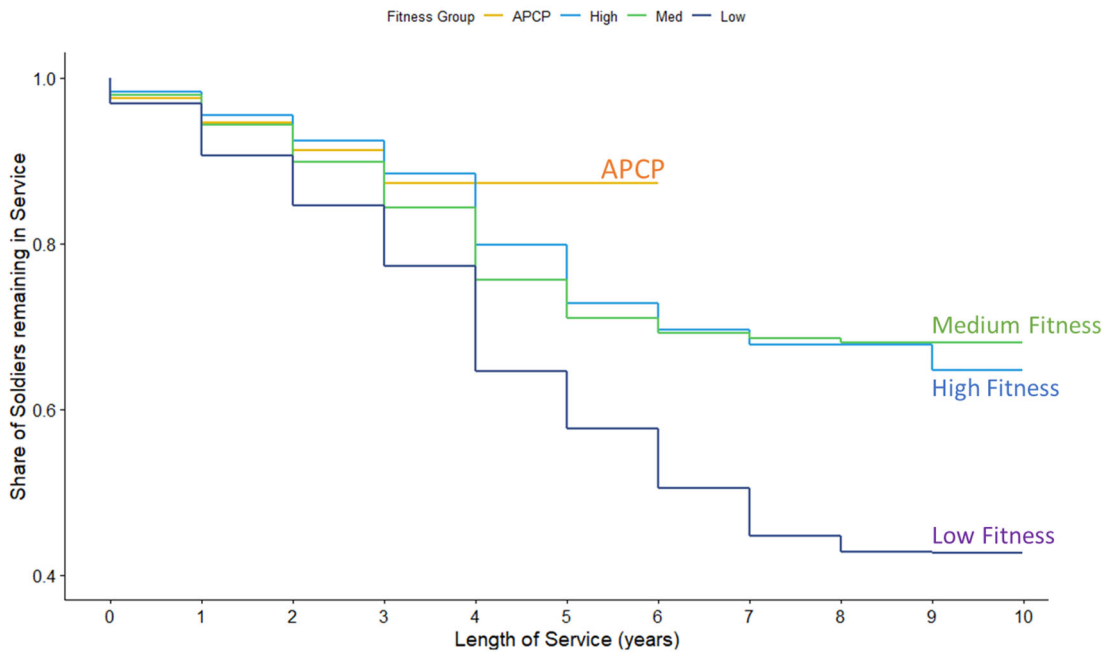


Figure 2. Kaplan-Meier survival curves for Soldiers

Figure 2 shows Soldiers in the APCP group track consistently with the High and Medium fitness groups for the first four years, at which point all remaining APCP participants continued to a maximum of six years, which is the approximate length of time between the introduction of the program and the end of the study period.

Soldiers in the High and Medium fitness groups maintain consistent survival levels throughout the study, indicating minimal differences in their length of service. In contrast, Soldiers in the Low fitness group consistently show lower survival rates compared to the High and Medium groups.

For Soldiers, the Initial Minimum Period of Service typically spans four or six years depending on their job role. At the four-year mark, around 78% of Soldiers in the High and Medium groups remain in service, while only 65% of Soldiers in the Low group do so. By the six-year mark, this disparity widens further, with 70% of Soldiers in the High and Medium groups remaining in service, in contrast to only 50% of Soldiers in the Low group. This 20% difference equates to approximately 1,600 additional Soldiers from the combined Medium and High fitness groups remaining in service, which is a significant step towards the Australian Army's growth target.

The Kaplan-Meier survival analysis affirms my second research question for both Officers and Soldiers, and shows a much larger disparity between the Low and High groups for Soldiers compared to Officers.

C. DISCUSSION

The regression analysis reveals that both Officers and Soldiers in the Low fitness group are more likely to fail initial training compared to those in the High fitness groups. The effects are relatively small, thus reducing the minimum fitness standard may not significantly impact training completion rates in the short term. Despite the higher likelihood of training failure for trainees with lower fitness levels, they may still complete training at an acceptable rate, aiding in achieving short-term recruitment goals.

Interestingly, the risk of training failure is more pronounced for Officers in the Medium fitness group compared to the Low fitness group (1.31 vs. 1.12), while for

Soldiers, the effect is more prominent in the Low fitness group (1.23 vs. 1.13). This implies that the Medium fitness level poses a higher risk of training failure for Officers.

However, the most notable impact of fitness level is observed in the survival rate differences between Low and High fitness groups for both Officers and Soldiers. This substantial difference, ranging from 10% to 20% after six years, is particularly significant for an Army requiring significant growth. Increasing the size of the trained force is possible if the total number of annual separations remains below the total number of annual initial training completions. Nevertheless, any adjustments to fitness standards must be accompanied by changes in physical training during initial training to prevent injuries.

The significant fall in survival rate at the nine-year mark for Officers in the Medium group can be linked to the Initial Minimum Period of Service for those individuals. Further research is recommended to analyze why this fall is not reflected in the High and Low fitness groups.

Additionally, logistic regressions indicate a slight increase in the likelihood of females failing to complete initial training compared to males, even after controlling for other factors. This suggests that while the minimum standards account for gender differences in strength, the requirement for both genders to complete physically demanding tasks early in their careers may hinder their transition into the trained force. Therefore, more efforts are needed to understand any hinderances and enhance the completion rate for female trainees.

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VI. CONCLUSION AND RECOMMENDATIONS

This research aims to inform decisions on minimum fitness standards for entry into the Australian Army, supporting recruiting and retention efforts amid significant growth. It sought to explore completion rates of initial training to enhance recruiting success and examine long-term service lengths to ensure adequate retention rates for organizational growth.

Findings indicate a statistically significant difference in initial training completion rates among fitness groups, although the magnitude of the effect could be considered marginal. Even individuals with a Low fitness level, noting all individuals in my dataset reached the minimum standard for entry, are highly likely to still complete initial training. If the Army reduces the minimum fitness standards to broaden the recruiting pool, a minor reduction of the initial training completion rate is expected. However, pairing changes to the fitness standards with modifications to the fitness program used during initial training, to support individuals with lower fitness levels, would be necessary to address the increased risk of injury.

The research highlights a more critical finding concerning retention, as evidenced by survival analysis. Officers in the Low fitness group exhibit a 10% lower survival rate at the six-year mark compared to those in the High fitness group, with Soldiers from the Low fitness group showing a 20% reduction. As an organization requiring significant growth the Australian Army must consider how this reduced survival rate could impact its retention strategies. If the minimum fitness standards were reduced, then it would be safe to assume the proportion of trainees with a low fitness level would increase and thus this 10–20% reduction in survival would apply to a larger proportion of the Officer and Soldier populations. This reduction of the survival rate could in turn trigger additional policy changes to boost recruitment and/or retention. This underscores the importance of balancing recruitment with retention when seeking organizational growth. We need to consider how policy changes will not only boost recruitment numbers but also how they affect the retention of trained and experienced personnel.

This study was limited to Australian Army personnel however the analysis could be applied to the Royal Australian Navy and Royal Australian Air Force as they also enter periods of growth. With minor modifications, other militaries including the United States, could also use this method of analysis to improve their understanding of the impact of the fitness level of their recruits.

APPENDIX A. BEEP TEST SCORING

Beep Test Recording Sheet

Date: _____

Time: _____

Surface: _____

Conditions: _____

1.1	1.2	1.3	1.4	1.5	1.6	1.7									
2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8								
3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8								
4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9							
5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9							
6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	6.10						
7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	7.10						
8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	8.10	8.11					
9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	9.10	9.11					
10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	10.10	10.11					
11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	11.10	11.11	11.12				
12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	12.10	12.11	12.12				
13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	13.10	13.11	13.12	13.13			
14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	14.10	14.11	14.12	14.13			
15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	15.10	15.11	15.12	15.13			
16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	16.10	16.11	16.12	16.13	16.14		
17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	17.10	17.11	17.12	17.13	17.14		
18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	18.10	18.11	18.12	18.13	18.14	18.15	
19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	19.10	19.11	19.12	19.13	19.14	19.15	
20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.10	20.11	20.12	20.13	20.14	20.15	20.16
21.1	20.2	21.3	21.4	20.5	20.6	21.7	21.8	20.9	20.10	21.11	21.12	21.13	21.14	21.15	21.16

Figure 3. Beep test scoring system. Source: Wood (2019).

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APPENDIX B. LOGISTIC REGRESSIONS

Table 7. Logistic regression results for Officers, in odds ratios, excluding observations containing pass with missing.

Analysis of Training Fail for Officers (excluding pass with missing)

	Dependent variable:				
	Training Fail				
	Fitness Group	+ Gender	+ Age	+ Married	+ Year of Enlistment
	(1)	(2)	(3)	(4)	(5)
Low	2.02***	2.01***	1.98***	1.99***	1.13***
	(0.19)	(0.20)	(0.20)	(0.20)	(0.26)
Medium	1.71***	1.69***	1.68***	1.68***	1.32***
	(0.20)	(0.21)	(0.21)	(0.21)	(0.22)
Female		1.05***	1.08***	1.08***	1.06***
		(0.16)	(0.16)	(0.16)	(0.16)
Age at Enlist			0.96***	0.96***	0.95***
			(0.02)	(0.02)	(0.02)
Married				0.93***	1.03***
				(0.35)	(0.35)
Cohort Fixed Effects	N	N	N	N	Y
Observations	1,665	1,665	1,665	1,665	1,665
Log Likelihood	-594.31	-594.29	-590.36	-590.28	-553.51
Akaike Inf. Crit.	1,194.61	1,196.57	1,190.73	1,192.56	1,139.02

Note: Standard errors in parentheses. The omitted category is High.
** p < 0.05; *** p < 0.01.

Table 8. Logistic regression results for Soldiers, in odds ratios, excluding observations containing pass with missing.

Analysis of Training Fail for Soldiers (excluding pass with missing)

	Dependent variable:				
	Training Fail				
	Fitness Group	+ Gender	+ Age	+ Married	+ Year of Enlistment
	(1)	(2)	(3)	(4)	(5)
Low	2.04***	2.00***	2.01***	2.01***	1.18***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.14)
Medium	1.42***	1.38***	1.38***	1.38***	1.15***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
APCP	1.61***	1.34***	1.32***	1.33***	1.62***
	(0.25)	(0.26)	(0.26)	(0.26)	(0.27)
Female		1.30***	1.29***	1.29***	1.19***
		(0.10)	(0.10)	(0.10)	(0.10)
Age at Enlist			1.01***	1.01***	1.01***
			(0.01)	(0.01)	(0.01)
Married				0.81***	0.81***
				(0.18)	(0.18)
Cohort Fixed Effects	N	N	N	N	Y
Observations	11,372	11,372	11,372	11,372	11,372
Log Likelihood	-2,264.35	-2,260.97	-2,260.47	-2,259.70	-2,138.21
Akaike Inf. Crit.	4,536.70	4,531.94	4,532.94	4,533.40	4,334.41

Note: Standard errors in parentheses. The omitted category is High.
** p < 0.05; *** p < 0.01.

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