

Food Warehouse Workers are at Increasing Injury Risk

A Thirty Year Retrospective

ADVANCED ERGONOMICS, INC.

Thirty years ago, a prospective validation study in food warehousing found that newly hired individuals whose measured physical abilities were less than the routinely encountered job demands experienced injury rates 2.5 times that of those whose measured physical abilities met or exceeded those demands. This study, completed by Advanced Ergonomics, Inc. (AEI) in 1990, identified a need for mitigation and a successful strategy to reduce this risk gap between routine food warehouse physical demands and the average job candidate abilities. In the years since this study was completed, AEI has completed detailed onsite analyses quantifying the strength and energy expenditure demands of food selector jobs in over 400 locations, comprising some 50,000 hours of energy expenditure monitoring of workers. During this same time frame AEI has evaluated and documented the physical strength and aerobic capacity of over 400,000 food warehouse job applicants. An analysis of this wealth of data over time indicates that the physical demand requirements in food warehouses has increased significantly while the physical abilities of the average job candidate have decreased, resulting in a risk gap that is now greater than ever.

Food Warehouse Physical Demands

The physical demands of the food order selector job can be quantified in terms of average case weight handled, number of cases handled per hour and maximum case weight handled routinely. While the maximum case weight handled routinely establishes the strength demand, the average case weight and number of cases handled over time indicate the overall work intensity. Specifically, the work intensity can be defined as the average total weight handled per hour (lbs/hr). Additionally, AEI has measured and quantified the physiological energy expenditure of workers in units of milliliters of oxygen used per kilogram^{2/3} of body weight per minute ($\text{ml} \cdot \text{kg}^{-2/3} \cdot \text{min}^{-1}$). This energy expenditure correlates with the overall work intensity metric.

While the maximum case weight handled routinely can vary between warehouses depending on product mix, the average case weight in food warehouses has remained consistent, at about 21 lbs. However, data from AEI analyses indicate that case handling frequency has increased significantly over time. As such, overall work intensity and physiological energy expenditure have correspondingly increased. Looking back only as far as 2007 reveals an average increase of 40% in cases handled per hour from 162.3 to 226.8. In terms of work intensity, this represents a change from workers handling an average of 3,408 lbs/hr in 2007 to now handling 4,763 lbs/hr on average. Measured average energy expenditure of workers has shown a similar increase of 37% overall, increasing from $42.07 \text{ ml} \cdot \text{kg}^{-2/3} \cdot \text{min}^{-1}$ to $57.46 \text{ ml} \cdot \text{kg}^{-2/3} \cdot \text{min}^{-1}$.

Job Candidate Physical Abilities

As mentioned previously, AEI has evaluated the physical abilities of over 400,000 food warehouse job candidates. While these physical abilities tests have included both strength and aerobic

capacity, or cardiovascular endurance, aerobic capacity is most often the determining factor in the ability of an individual to meet the job demands. This physiological measurement was also found in the AEI food validation study to have the strongest relation to productivity, tenure and decreased risk of injury. Additional measures that reflect on physical fitness include body weight and body mass index (BMI). The table below shows average fitness measurements for food warehouse applicants from 1989 to 2019. Average weight and BMI have shown increases for both females and males, while aerobic capacities have declined.

Table 1: Food Warehouse Applicant Fitness Measurements from 1989 to 2019.

Year	Females			Males		
	Average Weight (lbs.)	Average BMI (kg·m ⁻²)	Average Aerobic Capacity (ml·kg ⁻¹ ·min ⁻¹)	Average Weight (lbs.)	Average BMI (kg·m ⁻²)	Average Aerobic Capacity (ml·kg ⁻¹ ·min ⁻¹)
1989	157.8	26.92	30.54*	176	25.25	43.03
1999	160.98	26.81	36.02	187.12	26.77	41.68
2009	169.35	28.41	35.57	192.92	27.81	40.96
2019	182.3	30.36	33.03	194.72	28.09	40.57
% change 1989-2019	16%	13%	-8% (since 1999) *small sample	11%	11%	-6%

Risk of Injury

While the AEI food validation study showed that individuals whose physical abilities did not meet the physical job demands had 2.5 times as many injuries as those whose did, the question remains as to what current level of gap and associated risk of injury exists between the physical demands of the job and the physical abilities of the average candidate. As stated previously, the level of demand as defined in terms of work intensity has steadily increased, with the most recently projected average at 4,763 lbs/hr. It was also found that work energy expenditure correlated with and could be predicted by work intensity. According to guidelines by NIOSH, an individual can safely work over time at only a percentage of their maximum aerobic capacity, and that percentage decreases with increasing shift length. Figure 1 shows conservative predictions of overall energy expenditures for a range of average weights handled per hour, average case weights and shift lengths found in AEI energy expenditure data gathered over time. NIOSH has identified ranges of risk based on energy expended on the job and shift length. Those ranges have been translated into levels of need for intervention and overlaid on the predicted energy expenditures shown in Figure 1.

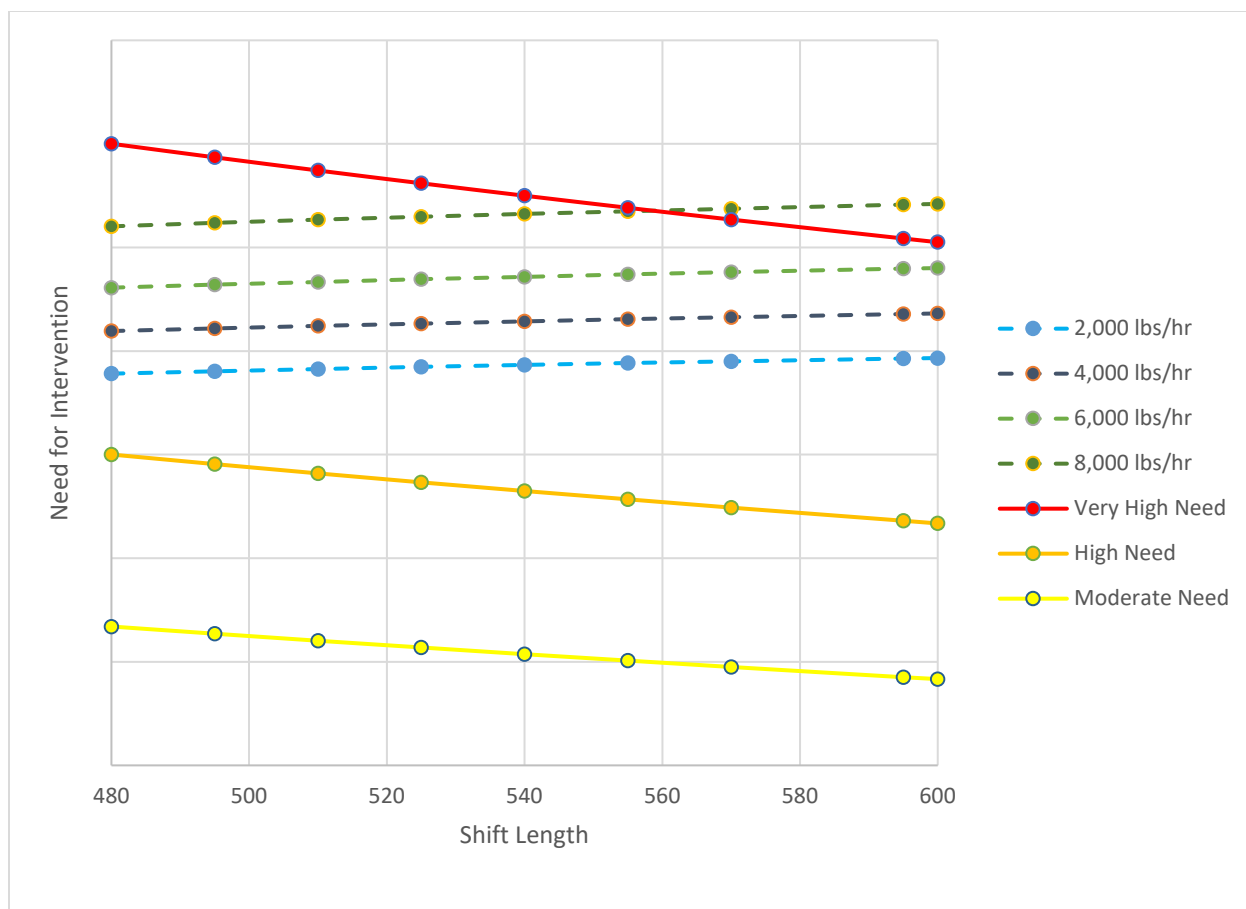


Figure 1: Need for Testing by Weight per Hour and Shift Length

It can be seen that all of the energy expenditures/work intensities universally fall above the “High Need” threshold, and some even above the “Very High Need” threshold at longer shift lengths. Also of note is that the most recently projected average work intensity of 4,763 lbs/hr falls above the chart average of 4,000 lbs/hr in the upper half of the “High Need” range. Reviewing this data in light of NIOSH guidelines we can conclude that even food warehouses at the lowest work intensity and shortest shift lengths fall into a high risk level in which mitigation should be considered.

Considering that the typical food warehouse average work intensity itself creates a high risk of injury to a substantial portion of food warehouse applicants based on NIOSH guidelines, the overall physical abilities of the applicant pool and typical job candidate should also be taken into consideration. AEI data for food warehouse applicants shows that typical measures of fitness, body weight and BMI, have increased over time, indicating a decline in overall fitness. Measures of male and female aerobic capacities have declined as well. Despite these challenges, food warehouses make continual efforts to increase the diversity of their workforce and in fact, data shows that the percentage of female food warehouse job candidates has increased over the last thirty years from 1% to currently 10%. However, given the overall increase in work intensity of food warehouse jobs, the average male aerobic capacity falls approximately 8% below the average

energy expenditure requirement and the average female aerobic capacity falls some 30% below. Given these deficits between food warehouse physical demands and typical applicant physical abilities, approximately 62% of job candidates do not have the fitness level at the point of hire to safely meet the average aerobic capacity requirement, or work intensity requirement of the job. Based on further injury rate studies performed by AEI, it is anticipated that this group of applicants would have roughly two times the risk of injury as those whose aerobic capacity meets or exceeds the job demand.

Mitigation Strategies

As the food industry has continued to apply administrative controls and safety measures to successfully reduce overall industry injury rates over the years, data shows increases in the overall work demand which continue to keep jobs at an elevated risk for injuries. This work demand combined with overall declining physical fitness of candidates creates an environment of continual risk, high actual injury experience and increasing costs that challenge business success. According to the National Safety Council, in 2018 the average total cost of each medically consulted workplace injury was \$41,000.

The real need for mitigation is apparent but the right solution is not as immediately obvious. Administrative controls such as warehouse layout and pick strategies for optimizing efficiency can only go so far toward decreasing physical demands. Ergonomic solutions such as rack height optimization or limits on pallet stack heights can help minimize safety risks but can only marginally impact the overall requirements of very physically demanding jobs. Engineering solutions such as automation can be extremely costly.

As has been shown, the average case weight has remained consistent over time but case handling rates have continued to increase, driving up overall work intensity for workers. These findings suggest three primary ways to mitigate injury risk:

1. Reduce the work demand;
2. Hire more workers to perform the same amount of work; or
3. Qualify and hire workers who can demonstrate the physical abilities to meet the work demand.

While reducing case handling requirements would seem an effective mitigation strategy, thin profit margins and high competition in the food industry render this an unlikely, if not impossible proposition. Additionally, even a substantial reduction on the order of 30% would still find over 30% of job candidates lacking the fitness to meet the lower demand. Likewise, hiring additional employees to perform the same amount of work would increase costs.

Though the first two mitigation strategies are likely unfeasible for most employers, the option of qualifying candidates for the job demands is a well-founded strategy that has proven effective, cost-efficient and legally defensible. The AEI physical abilities testing program for example, which specializes in an engineering approach for quantifying work intensity and energy expenditure demands, has shown an average decrease of 41% in overall injury rates for new hires.

The program has shown even higher average decreases in sprain/strain types of musculoskeletal injuries like back injuries that are costly and common in food warehouses. These decreases in injuries have provided substantial cost savings for employers, resulting in significant return on investment.

Conclusions

Retrospectively reviewing the volume of data collected by AEI over the last thirty years from over 400 food warehouse locations, over 50,000 hours of energy expenditure data and over 400,000 job candidate physical abilities evaluations, we can identify trends that provide insight into current challenges in the food industry. Most apparent is that physical job demands in the average food warehouse have increased significantly over time, primarily due to increasing case handling rates. This increase has contributed to an overall work intensity and associated energy expenditure requirement that NIOSH considers to be in high need of mitigation. In the same time frame, the average body weight and BMI of job candidates has increased and the overall average aerobic capacity has decreased, resulting in approximately 62% of job candidates having lower fitness levels than the average job requirements. These candidates are approximately twice as likely to experience a job related injury in a food warehouse as those with fitness levels that meet or exceed the job demands. As such, there is an obvious need for mitigation to reduce this risk gap and the associated injuries, costs and negative impacts on business.

As has been explored, mitigation could be accomplished by lowering work demands, i.e. productivity requirements, or by adding headcount to accomplish the same work output. However, these approaches are not likely to be feasible given their costs that would decrease profits. A mitigation strategy that has proven repeatedly over time to be effective, cost-efficient and legally defensible is the use of job-specific physical abilities testing in the employment process. By qualifying job candidates as capable of meeting the essential physical demands of the job, employers can drastically lower their overall injury experience and associated costs as well as lower turnover.

The AEI physical abilities testing program is based on an ergonomic and engineering approach that is founded in three separate prospective validation studies performed in the industries of beverage, retail and food warehousing and distribution. With the unique and proprietary focus on the primary demands of strength and energy expenditure, the AEI program has proven very successful, particularly for industries and jobs having high work intensity demands like food warehouses. Having conducted over one million evaluations of job candidate physical abilities for employers to date, AEI has documented an average of 41% reduction in new hire injuries, 21% decrease in turnover and complete success in legal defensibility in multiple reviews from a variety of governmental agencies. Given the typical cost of the average workplace injury, physical abilities testing continues to provide a very feasible mitigation strategy that is effective and cost-efficient, resulting in a high return on investment.