LADDER SAFETY FOR WOMEN WOR
Integrating Evidence into Safety Management Syst

By Ronilla Ernest

LADDER-RELATED FALLS and injuries remain a leading cause of occupational injuries and fatalities despite well-established safety standards and training requirements. Ladder-related falls continue to account for a substantial share of fatal and non-fatal workplace injuries, particularly in construction, installation, maintenance and repair activities (NIOSH, 2024; Socias et al., 2014). Nonfatal ladder falls frequently result in fractures, sprains and other musculoskeletal outcomes, as well as lost work time, imposing significant human and organizational costs. In 2020, the United States recorded 22,710 workplace ladder injuries and 161 fatalities (NIOSH, 2024).

Ladders present a distinct safety challenge because they require workers to maintain balance, grip, foot placement and postural control while performing work at elevation. Compared with scaffolding or elevated work platforms, ladders provide limited working surface area and limited recovery time when a slip, missed rung, overreach or load shift occurs.

Biomechanical ladder research shows that recovery from a perturbation is influenced by factors such as climbing direction, hand placement, upper-body strength, foot placement and gender-related differences (Hsiao et al., 2008; Pliner, 2020; Pliner, Seo et al., 2016). These characteristics make ladder safety especially sensitive to ergonomic mismatches, when equipment design, task demands or PPE fit exceed the worker's available reserve capacity.

KEY TAKEAWAYS

- **Ladder safety programs that rely on male anthropometric assumptions can unintentionally increase fall and musculoskeletal injury risks for workers whose physical capabilities may not match those assumptions, including many women.**
- **Integrating ergonomic ladder design, capability-based training and properly fitted PPE into existing safety management systems (SMS) can reduce ladder-related injuries without deviating from existing regulatory and consensus standards.**
- **This article translates physiological and ergonomic evidence into practical, SMS-aligned strategies for ladder selection, task planning, training and performance measures that maximize safety for all workers.**

Ladder Safety

Ladders are essential tools across many industries, including construction, warehousing, facilities maintenance, utilities and emergency services. Although ladder-intensive occupations remain male-dominated, data shows that women workers participate across occupational groups including construction, installation, maintenance, repair, service, production and transportation, though their representation varies by occupation (U.S. BLS, 2026). While women are still underrepresented in construction, the share of the construction workforce made up by women workers increased from 9% to 11% between 2011 and 2022, a relative increase of 19% (Trueblood et al., 2023). Ladder safety programs that assume a single default user type can exclude a meaningful portion of the workforce who fall outside the intended design and training parameters (U.S. BLS, 2025, 2026).

Unlike fixed access systems, ladders are frequently repositioned, used for short-duration tasks, and employed under varying environmental and workload conditions. These factors increase exposure because of dynamic risk factors such as fatigue, overreaching, load handling and balance perturbations. From an organizational risk management perspective, ladder-related injuries are associated with lost productivity, medical costs, workers' compensation claims and operational disruptions.

While this article focuses on ladder safety considerations for women workers, the underlying ergonomics principles discussed are applicable to any worker whose physical characteristics fall outside the traditional design assumptions. This includes but is not limited to workers of smaller stature, older workers, and

SEBASTIAN GORCZOWSKI/ISTOCK/GETTY IMAGES PLUS



RKERS o tems

individuals with reduced grip strength, joint instability or prior musculoskeletal injuries. Framing ladder safety through a capability-based ergonomic lens allows risk to be addressed according to functional demands, not just demographic category.

Ladder standards and regulatory requirements establish important dimensional and performance parameters such as rung spacing, step spacing and minimal clear width. For instance, OSHA requires ladder rungs, steps and cleats to be uniformly spaced and generally between 10 and 14 in. apart, with minimum clear-width requirements for portable and fixed ladders (OSHA, 2024). Compliance with these dimensional requirements does not by itself confirm that a ladder is equally suitable for and usable by every worker. It does not ensure suitability across every task condition. National anthropometric datasets, including those from the National Health and Nutrition Examination Survey and the Anthropometry Survey of U.S. Army Personnel, document substantial variation in stature, limb dimensions, body size, and reach across gender and population groups (Gordon et al., 2014; National Center for Health Statistics, 2022). When ladder geometry, task duration, reach distance, load handling or PPE fit approaches an individual worker's functional limits, the resulting ergonomic mismatch can reduce grip reserve, balance recovery capacity and postural control, thereby increasing the risk of fall and musculoskeletal injury.

The available surveillance data should be interpreted carefully. National data identify men as having higher overall ladder fall injury rates, likely reflecting greater exposure in ladder-intensive occupations; however, these data do not fully normalize risk by ladder task, exposure duration, ladder type, work height, PPE fit or specific job demand (NIOSH, 2024). It is important to note that this article does not argue that women have higher overall ladder injury incidence in every setting. Instead, it makes the case that documented physiological, anthropometric and PPE-fit factors can reduce the margin of error during specific ladder tasks, especially when the same ladder design or work procedure is applied uniformly across workers with different functional capacities.

Population-level physiological and anthropometric differences are relevant to ladder safety because ladder-related tasks require simultaneous grip, balance, reach, lower-extremity stability and recovery capacity. Research on ladder perturbations found greater fall severity among women participants compared to men participants during both ascent and descent, while other ladder studies identify upper-body strength, hand placement, foot placement, climbing direction and recovery response as important factors in fall outcomes (Pliner, 2020; Pliner, Seo et al., 2016; Pliner, Sturnieks et al., 2024). These findings support a capability-based approach to ladder risk assessment instead of a one-size-fits-all approach to ladder selection and training.

For EHS professionals, addressing ladder safety for women workers is not a matter of lowering expectations, accommodation or creating separate rules. It is a matter of identifying where equipment, task design, training and PPE fit may not align with the functional demands placed on workers. International EHS guidance emphasizes that gender differences should be considered in risk management, worker participation, research, PPE selection and prevention strategies (International Labour Office, 2009).

Ladder Safety Within a Safety Management System

Ladder-related safety risks are most effectively managed when they are embedded within an organization's safety management system (SMS), where hazards are systematically identified, assessed, controlled, monitored and continuously improved. This approach is consistent with OSHA's Recommended Practices for Safety and Health Programs and systems-based frameworks such as ANSI/ASSP Z10 and ISO 45001, which emphasize worker participation, hazard

identification, risk control, training, performance evaluation and continuous improvement (ANSI/ASSP, 2019; ISO, 2018; OSHA, 2016). Integrating ladder safety into SMS processes ensures that ladder use is treated as a recurring operational exposure instead of an isolated compliance task.

Figure 1 illustrates the feedback loop used to manage ladder-related ergonomic risk within an SMS. The arrows represent the flow of information and control decisions throughout the system. Hazard identification informs control selection, training, communication, performance monitoring and incident analysis. Findings from monitoring and incident analysis, near-miss reports and field observations then feed into hazard identification and risk assessment. Figure 1 makes clear that ladder safety should be treated not as a one-time training topic but as a recurring operational exposure that must be reviewed as workers, tasks, equipment and job conditions change.

Stakeholder & Subject Matter Expert Involvement

Inclusive ladder safety practices require input from multiple stakeholders, including women workers, supervisors from ladder-intensive job groups, EHS professionals, procurement specialists and ergonomics experts. Worker participation is a core element of effective safety management because employees can identify task realities, equipment limitations and PPE fit problems that may not be visible in written procedures or procurement specifications (International Labour Office, 2009; OSHA, 2024). Involving end users in ladder selection, job hazard analysis, field trials, and procedure development helps ensure that equipment and work practices align with actual ladder use demands.

Hazard Identification & Risk Assessment: Physiological & Ergonomic Considerations

Ladder-related hazards frequently arise during tasks that require simultaneous balance, grip, foot placement and postural control while performing work at elevation. These demands increase during extended-duration tasks, repeated climbing cycles, tool handling, lateral reaching, load carrying, descent, and transitions between the ladder and work surface. As fatigue develops, available grip strength, balance recovery capacity and joint stability can diminish, narrowing the margin for error and increasing the likelihood that minor perturbations progress to falls.

These demands are not gender exclusive, but they are gender relevant. On average, women have lower absolute grip strength and upper-body strength than men, and ladder perturbation research has found greater fall severity among women participants under some ascent and descent conditions (Mathiowetz et al., 1985; Pliner, Seo et al., 2016). Research examining ladder use ability, behavior and exposure across age and gender groups further indicates that ladder safety outcomes are influenced by the interaction between physical capability, task conditions, individual behavior and exposure frequency (Pliner, Sturnieks et al., 2024). Complementary research on ladder climbing mechanics and fall recovery found that fall risk was influenced by climbing direction, number of contact points and gender, supporting the need to evaluate ladder safety as a biomechanical and work-system issue rather than solely as a matter of compliance with prescribed behaviors (Beschorner et al., 2015). These physiological and biomechanical considerations become particularly relevant when evaluating ladder design and task conditions in real-world applications.

FIGURE 1
INTEGRATING LADDER SAFETY INTO AN SMS



Ladder Design & Task Conditions

Ladder design and task conditions directly influence the level of physical effort, reach, grip force and postural control required of the worker during ladder use. Factors such as rung spacing, ladder angle, step rise, rail width, handhold availability, and surface conditions can affect usability and stability, especially when workers must simultaneously manage tools, PPE, time pressures, and awkward or otherwise suboptimal working positions. These considerations are especially relevant for women workers because differences in stature, hand dimensions and grip strength may reduce the available margin of safety when ladder design or task demands are not matched to the worker.

Available evidence supports a broader safety management expectation that ladder tasks should be evaluated in relation to the worker, the equipment and the task being performed rather than through a single women-specific ladder design requirement. Accordingly, safety professionals should assess whether the ladder provides stable foot placement, handholds are accessible, the worker can maintain three points of contact, the PPE fits properly without interfering with movement or grip, and the task requires reaching or forceful exertion while on the ladder. When the adequacy of these conditions is uncertain, the safer approach is to redesign the task or select an alternative means of access rather than rely on training alone.

Core Ergonomic Risk Factors Relevant to Ladder Use

Ladder use requires the simultaneous coordination of grip strength, balance control, reach and lower-extremity stability under dynamic conditions. Variability in these physiological and biomechanical factors can influence a worker's available margin of error, particularly when tasks involve descent, overreach, load handling or extended duration. Understanding these core ergonomic risk factors is essential for evaluating ladder suitability and identifying conditions where additional controls may be necessary.

Grip Strength & Hand Size

Normative hand-strength data consistently show gender-related differences in average grip strength across adult age groups (Mathiowetz et al., 1985; Wang et al., 2018). During ladder use, the safety concern is not just maximum grip strength; it is grip reserve under dynamic task conditions. A worker may be able to grasp a rung under normal conditions but have less reserve capacity during descent, fatigue, overreaching, tool handling or a sudden perturbation. Ladder perturbation research indicates that recovery from ladder fall events depends on the circumstances of the perturbation such as climbing direction, number of contact points and gender, with higher fall risk during descent and when only two extremities contacted the ladder rather than simply the worker's maximum hand force (Beschorner et al., 2015; Pliner, 2020; Pliner, Seo et al., 2016).

Figure 2 illustrates the population-level differences in the mean grip strength between adult women and men based on normative datasets. This figure contextualizes relative grip strength differences relevant to ladder use demands; it does not represent task-specific grip force requirements or predict individual performance. Because these values are population-level clinical measurements, Figure 2 should not be interpreted as a screening tool for individual ladder access. The purpose of the figure is to make the case that ladder risk assessment should account for grip reserve, glove fit, rung characteristics and task demands, instead of assuming that all workers have the same recovery capacity.

It should be noted that although Mathiowetz et al. (1985) is a clinical reference, its normative values are widely cited in ergonomics literature and remain useful for illustrating relative grip strength differences at the population level. Clinical grip strength measurements do not replicate dynamic ladder grasping but provide a conservative indicator of available grip reserve.

Center of Gravity & Balance Stability

Dynamic balance demands increase during ladder ascent, descent, turning, lateral reaching, carrying tools, and transitioning on and off the ladder. These conditions are important from a gender-informed standpoint because differences in stature, reach, center of mass distribution, lower extremity control and available strength can change how much reserve capacity remains during the same ladder-related task. Recent ladder-use research supports evaluating ladder safety through the interaction of age, gender, behavior and exposure instead of static ladder use alone (Pliner, Sturnieks et al., 2024).

Joint Laxity & Lower-Extremity Stability

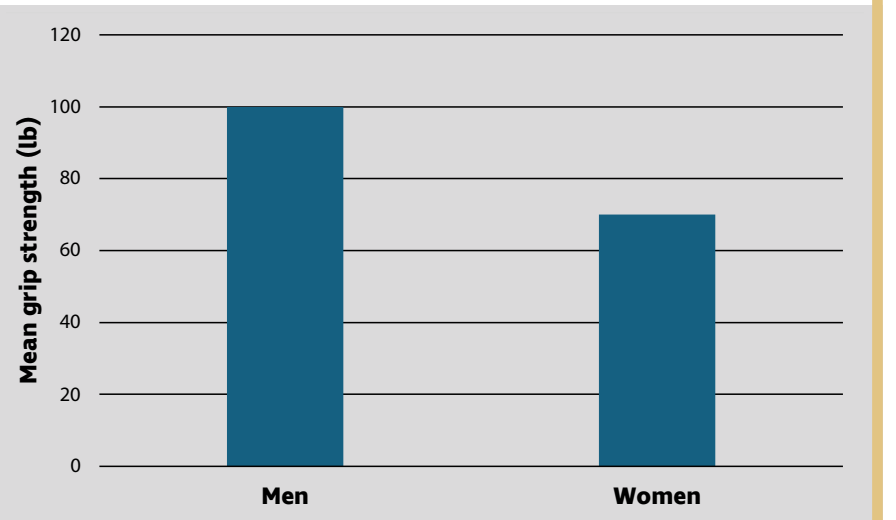
Joint stability is relevant to ladder safety because slips, missed rungs, uneven footing and rapid descent require the worker to recover quickly through the knees, hips and ankles. Gender-related differences in knee biomechanics and ligament injury risk have been documented in broader biomechanics literature, but the practical ladder-safety implications should be considered carefully. Where lower-extremity stability or recovery capacity is reduced, ladder tasks involving descent, uneven surfaces, lateral reaching or load handling may require additional controls such as stabilizers, platform ladders, secured ladder placement, improved footing and reduced load-carrying demands (Hewett et al., 2016; Pliner, Seo et al., 2016).

Upper Body Strength & Load-Carrying Limits

Ladder-related tasks that require carrying tools or materials increase upper-body demand, reduce hand availability and may shift the worker's center of mass. These effects are especially

FIGURE 2

DIFFERENCES IN MEAN GRIP STRENGTH RELEVANT TO LADDER USE



Note. Data adapted from Mathiowetz et al. (1985).

important for workers with lower grip or upper-body reserve because carrying objects can reduce the ability to maintain three-point contact or recovery from a perturbation. Ladder biomechanics research identifies descent, hand placement, foot placement and upper-body strength as factors relevant to fall severity, while ladder-safety guidance emphasizes choosing the right ladder and avoiding conditions that compromise balance or contact (NIOSH, 2024; Pliner, 2020; Pliner, Seo et al., 2016). Carrying tools or materials can reduce hand availability, shift the worker's center of mass and reduce ability to maintain stable contact with the ladder. For this reason, ladder tasks involving load handling should be evaluated for tool staging, hoists, lift-assist methods or alternative access before work begins.

Table 1 summarizes key physiological and ergonomic mechanisms that are relevant to ladder use and identifies corresponding safety implications for job hazard analysis, procurement, training and incident review (Mathiowetz et al., 1985; Onyebeke et al., 2016; Pliner, 2020; Pliner, Seo et al., 2016).

Hazard Controls Using the Hierarchy of Controls

Consistent with the hierarchy of controls, ladder-related risks can be addressed first by eliminating or substituting ladder use where feasible, then by engineering controls, administrative controls and PPE. The gender-informed connection is direct—substitution reduces exposure time; engineering controls reduce reliance on individual grip and balance recovery; administrative controls prevent overreach, load carrying and prolonged ladder work; and properly fitted PPE helps preserve grip, footing and movement. These controls are especially important when task demands approach the worker's available physiological reserve, which can occur for any worker outside the assumed design range, including many women workers (NIOSH, 2024; Onyebeke et al., 2016; Pliner, Seo et al., 2016).

Table 2 demonstrates how ladder-related risks can be addressed using the hierarchy of controls within an SMS framework.

Engineering & Substitution Controls

Engineering and substitution controls reduce reliance on individual worker capacity by changing the equipment or access method. Ladder design characteristics that should be considered include rung spacing, step rise, rung or step surface texture, ladder angle, ladder height, rail or handhold configuration, clear width, platform availability, and ladder stability. OSHA establishes minimum ladder requirements, including rung spacing and clear width, and NIOSH research on aerial ladder rung spacing found that reducing rung spacing from 14 to 12 in. reduced hand forces, foot forces and ankle twisting and increased climbing speed for women participants in the study (OSHA, 2024; Simeonov et al., 2020). Although this evidence does not justify a universal design mandate for every ladder type, it does support the need to evaluate whether the compliant ladder dimensions are usable for the specific workforce and task at hand.

Substitution controls include replacing ladders with mobile work platforms, scaffolds or other access methods for extended-duration, high-reach, repetitive or tool-intensive tasks. From a gender-informed perspective, substitution is not an accommodation after the difficulty occurs; instead, it is a prevention strategy for when the task requires sustained grip, reach, balance or load handling beyond a reasonable margin of safety.

Administrative Controls & Procedures

Traditional ladder safety training often emphasizes rule-based guidance, such as maintaining a three-point contact, facing the ladder and avoiding overreach. These rules remain important, but they may be insufficient when the task exceeds

TABLE 1

PHYSIOLOGICAL & ERGONOMIC RISK FACTORS RELEVANT TO LADDER USE

Risk factor	Evidence base	Gender-informed safety relevance	Ladder exposure	Practical control
Grip strength and hand size	Normative strength data, ladder perturbation research	Average grip reserve, glove fit and handhold contact	Slips, descent, overreaching, tool handling	Evaluate rung surface, glove fit, handhold access, task duration and load carrying
Dynamic balance and reach	Ladder-use behavior and biomechanical research	Affects overreach, stability and recovery margin	Lateral reaching, transitions, uneven surfaces	Use correct ladder height, platform ladders, stabilizers or repositioning
Lower-extremity stability	Biomechanical and fall-recovery literature	Affects recovery from missed rungs, missteps or unstable footing	Missed rungs, descent, uneven footing	Secure ladders, improve footing, use anti-slip controls, provide descent-focused training
Upper-body load and task duration	Ladder biomechanics, safety guidance	Reduces reserve during carrying or prolonged work	Carrying tools, repeated climbs, prolonged tasks	Stage tools, hoist or lift-assist materials, or provide alternative access
PPE fit	PPE research, gender-sensitive EHS guidance	Poorly fitted PPE can affect grip, footing, harness function or movement	Gloves, boots, fall protection, clothing	Provide size ranges, fit verification, field trials and worker feedback

the worker's functional capacity or when the ladder is not appropriate for the task. Ergonomics-informed ladder programs should include task-based ladder selection criteria into the job hazard analyses and pretask planning. At a minimum, the assessment should include task-based ladder selection, duration, reach distance, ladder height, work surface, descent frequency, load handling, PPE fit, environmental conditions and whether both hands are available for climbing. This is particularly important because fall recovery research indicates that maintaining three points of contact may be more protective than relying on gloves alone, and descent and reduced contact may increase fall risk (Beschorner et al., 2015).

From a gender-informed ergonomic perspective, this means that safety professionals should not expect women workers to compensate for poor ladder fit, excessive reach, oversized PPE, or load-carrying requirements through being careful or extra cautious. Instead, the procedure should define clear escalation triggers for safety access methods before the work begins.

TABLE 2

APPLICATION OF THE HIERARCHY OF CONTROLS TO LADDER SAFETY

Control level	Ladder-specific examples	Risk addressed	Gender-informed value	SMS element
Elimination or substitution	Platforms, scaffolds or alternate access methods for extended duration, high-reach, repetitive or tool-intensive work	Exposure, fatigue, overreach, load handling	Reduces reliance on grip, reach and balance reserve	Hazard prevention and control
Engineering	Platform ladders, integrated handrails, stabilizers, anti-slip surfaces	Balance loss, descent risk, recovery demand	Supports broader range of reach, grip and stability	Risk reduction and procurement
Administrative	Task-based selection, job hazard analysis, pretask planning, escalation criteria	Overreach, incorrect ladder selection, load handling	Shifts focus from worker adaptation to task design	Procedures and training
PPE	Provide properly fitted gloves, boots, harnesses and clothing	Grip loss, footing instability, movement restriction	Prevents PPE fit from becoming an added hazard	Worker protection and procurement

TABLE 3

TASK-BASED LADDER SELECTION & ESCALATION MATRIX

Task characteristic	When ladder use may be appropriate	Risk & escalation trigger	Preferred control
Short duration, low reach	The worker can remain centered with stable footing and both hands available	Fatigue and reduced reserve due to duration increases, or positioning becomes unstable	Use platform ladder or work platform
Lateral reaching	Work stays within the rails and the ladder can be repositioned	Overreach, balance loss due to twisting or leaning	Reposition ladder or use platform
Tool handling	Tools are staged or secured, without affecting grip or balance	Grip reduction and instability due to hands being unavailable or load shifts worker's center of mass	Stage tools, hoist materials or use alternative access
Descent or repeated climbing	Descent is controlled, contact is maintained and surfaces are stable	Recovery failure due to repeated descent, slippery rungs, poor footing	Add anti-slip controls or use alternate access
PPE interference	PPE fits properly and does not restrict movement	Reduced grip, footing and proprioception due to oversized, loose, restrictive PPE	Replace or adjust PPE before task begins

Table 3 (p. 29) provides a task-based ladder selection and escalation matrix to help supervisors and workers determine when ladder use is appropriate and when a safer access method is needed. The matrix shifts the decision from individual adaptation to task design by identifying conditions such as overreach, tool handling, PPE interference and extended duration.

PPE

PPE fit and performance are critical determinants of ladder stability and fall prevention. For women workers, PPE fit problems are not limited to comfort. Research on women construction workers found persistent problems accessing properly fitting gloves, harnesses, safety vests, work boots and outerwear, with many participants reporting that equipment provided by contractors was too large (Onyebeke et al., 2016). Ill-fitting gloves can reduce effective grip on ladder rungs and tactile feedback; oversized or poorly fitted footwear can compromise foot placement on rungs or steps; poorly fitted harnesses, fall protection systems, high-visibility vests, or outerwear can interfere with mobility, balance and secure positioning; and loose clothing can catch or shift during climbing. Gender-sensitive EHS guidance emphasizes that PPE selection should account for differences in body size and worker needs (International Labour Office, 2009). Therefore, PPE procurement should include size ranges, fit verification and field feedback from women workers before equipment is standardized.

Training, Communication & Competency Development

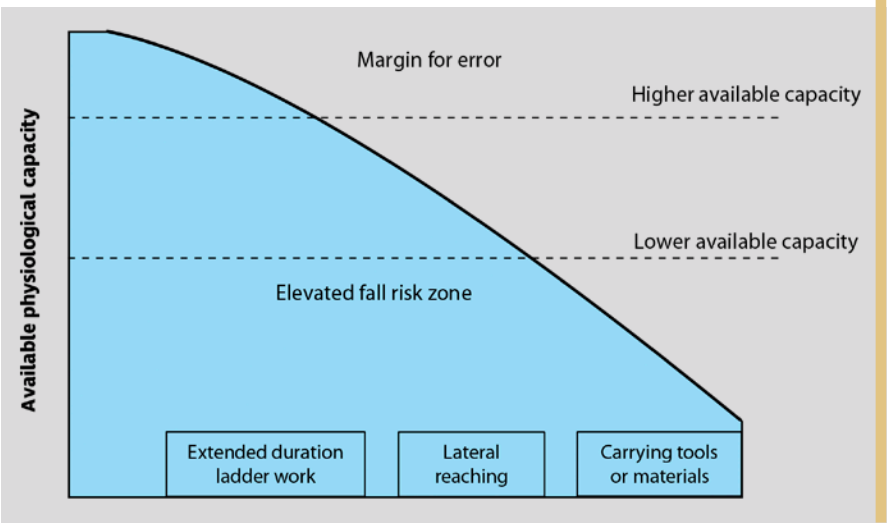
Effective ladder safety programs incorporate ergonomics- and gender-informed training and education that emphasizes capability-based decision-making and timely escalation to safer access methods when task demands approach or exceed worker capacity. The purpose is not to single out women workers but to help all workers and supervisors recognize when the ladder, task or PPE fit reduces the available margin of error. From a gender-informed perspective, this approach extends beyond reiterating the general rule-based guidance, such as maintaining three points of contact or avoiding overreach. Instead, training should equip supervisors and workers to recognize how ladder design, task duration, tool handling, PPE fit, reach distance and surface conditions can interact to create a potential mismatch between task demands and worker capability. Training should include ladder selection and setup, climbing posture, descent control, grip technique, ladder angle, body positioning, reach limits, tool handling, fatigue recognition, PPE fit and escalation to safer access methods. Capability-based training, as opposed to purely rule-based instruction, enables workers to identify when ladder use exceeds safe functional limits and when alternative access methods such as platform ladders, mobile work platforms, scaffolding or other engineered solutions are warranted. It is particularly important that hands-on training be conducted under realistic task conditions since risks often emerge during movement, descent, load handling and transition points instead of static standing.

Figure 3 illustrates the conceptual relationship between ladder task demands (reach distance, task duration, load handling and task complexity) and available physiological capacity. The upper area represents conditions where available capacity is sufficient and the margin for error is greater. The lower shaded area represents an elevated fall-risk zone where task demands approach or exceed available capacity. This figure is intended as a pretask discussion tool, not as a quantitative prediction model. Figure 3 can be used as a pretask discussion tool to identify when ladder-task demands may reduce the worker's margin of error and require escalation to safer access methods.

Safety professionals should determine where the task falls within the figure by evaluating observable conditions including duration of ladder use, amount of lateral reach, descent frequency, load handling, work height, surface conditions, ladder angle, PPE fit, worker fatigue and whether the worker can maintain stable hand and foot contact. Gender alone should not be used to place a worker in a high-risk zone. However, because average grip strength, reach, upper-body strength and PPE fit may differ between women and men, these factors should be considered when evaluating whether a ladder task has adequate margin for error.

FIGURE 3

LADDER TASK DEMANDS, PHYSIOLOGICAL CAPACITY & FALL-RISK MARGIN



Conditions may be considered lower risk when task demands are brief, stable and well matched to the worker's available physiological capacity. Risk increases as tasks involve extended duration, lateral reaching, tool handling, repeated climbing, awkward or sub-optimal positioning, uncertain PPE fit, or environmental instability. Conditions should be considered elevated risk when multiple demands occur concurrently, such as carrying tools while climbing, reaching beyond the ladder rails, working from an unstable surface, or continuing ladder use in the presence of fatigue. In such instances, the appropriate response is to redesign the task, select alternative access methods or equipment, or implement additional controls before work proceeds.

Ladder safety expectations should be reinforced through toolbox talks, pretask briefings, visual reminders, supervisor and EHS professionals' observations, and worker feedback. These communications

should explicitly include PPE fit, ladder selection, overreach, tool handling, descent and escalation criteria and should not be limited to discussion of three points of contact and other generalized safety training.

Performance Measurements & Continuous Improvement

Monitoring ladder safety performance within an SMS requires use of both leading and lagging indicators to evaluate effectiveness and guide continuous improvement. Leading indicators provide proactive insight into ladder safety performance before injuries occur. Examples include ladder inspections, verification of proper ladder setup and conditions, work observations, assessing climbing posture and overreaching behaviors, confirmation of PPE fit, review of ladder-selection decisions, and near-miss or good-catch reporting related to ladder use. Tracking these leading indicators allows EHS professionals to identify emerging risks and develop risk prevention strategies earlier in the process.

Lagging indicators include ladder-related injury rates, severity of injuries, lost work time, workers' compensation claims and incident trends. Where feasible, these data should be disaggregated by gender and reviewed by task, ladder type, work height, task duration, body part injured, PPE used and incident mechanism. This is vital because aggregate injury counts may obscure whether women workers are experiencing different patterns of near misses, PPE fit issues, overreach events or musculoskeletal outcomes. While lagging indicators do not prevent incidents directly, they help EHS professionals evaluate program effectiveness and identify priority areas for intervention.

Implications for Safety Practice

When viewed through an SMS framework, ladder safety controls should include hazard identification, engineering and administrative controls, PPE, training, performance monitoring, and incident analysis. For women workers, the practical implication is that ladder safety should be designed into work instead of being left up to individual adaptation. Procurement should include ladders and PPE that accommodate a broader range of body sizes, reaches and grip needs. Job hazard analyses should identify tasks involving sustained reach, repeated descent, load handling, poor footing or PPE interference. Supervisors should be trained to recognize escalation triggers and authorize safer access methods without treating the need as a performance issue.

Integrating ergonomic ladder design, capability-based training, and properly fitted PPE into existing SMS processes can be achieved without undue complexity or cost and without deviating from regulatory or consensus standards. This approach also supports business continuity by reducing injury-related lost time, workers' compensation costs and operational disruptions.

Available occupational injury surveillance data likely underrepresents near misses, PPE fit problems, task-specific exposure duration and ladder-use frequency by gender. As a result, organizations should not rely solely on injury counts to determine whether ladder controls are effective for women workers. These internal data sources—near-miss reports, worker feedback, PPE replacement records, job hazard analysis findings and supervisor observations—should supplement injury counts by helping organizations proactively identify equipment, PPE, task or training gaps before they result in injury.

Incident Analysis & Corrective Action

Analysis of ladder-related incidents should examine contributing factors such as incorrect ladder selection, excessive reach, insufficient grip, poor footing, descent, load handling, unstable setup, environmental conditions, fatigue, PPE interference or inadequate task planning. From a gender-informed standpoint, incident investigations should also determine whether the ladder, gloves, footwear, harness and work procedure fit the worker and the task. This approach helps frame the focus away from worker behavior when the underlying issue may be equipment and task mismatch.

An SMS-based approach ensures that lessons learned from ladder incidents and near misses are systematically translated into procurement changes, procedure revisions, training updates and field verifications. Regular review of ladder-related data enables organizations to refine controls so that ladder use is better aligned with worker capability and task demands.

Conclusion

The evidence reviewed in this article does not suggest that women are inherently unable to use ladders safely. It supports a clear prevention strategy: Ladder safety programs based on uniform assumptions may not fully address risk for women workers or other workers whose functional capacity falls outside the assumed design range across an increasingly diverse workforce. The available surveillance data do not prove that women experience higher overall ladder injury rates in every occupational settings. However, ladder biomechanics, anthropometric data and PPE fit research show that factors such as grip strength, reach, balance recovery, upper-body strength, ladder geometry and PPE fit can affect the margin of error during ladder use.

For women workers, these factors become safety-relevant when ladder tasks require prolonged climbing, descent, lateral reaching, load handling, poorly fitted PPE, or work performed from ladder designs that do not accommodate a broad range of users. The appropriate response is not to place the burden of responsibility on individual workers to compensate, but to strengthen the SMS by selecting appropriate ladders, designing tasks to reduce overreach and load handling, providing properly fitted PPE, training workers and supervisors to recognize escalation triggers, and using leading indicators to identify mismatch before injuries occur.

Capability-based ladder safety benefits women workers and applies broadly to all workers whose body dimensions, strength, reach, balance demands or PPE fit needs differ from traditional design assumptions, thereby improving safety for the entire workforce. The central issue is not whether women workers can use ladders safely—they can and they do—but whether ladder selection, task design, PPE and control measures have been appropriately evaluated for the actual workforce performing the work. By integrating ergonomic evidence into ladder selection, task planning, training, PPE procurement and continuous improvement, EHS professionals can close a practical gap in fall prevention and align ladder safety programs with the realities of an increasingly diverse workforce. **PSJ**

Acknowledgments

I gratefully acknowledge Cory Worden for providing detailed, actionable feedback that helped strengthen the structure, organization and clarity of this article. I also thank Randy Milliron for his thoughtful insights and professional perspective during the review process. I am especially grateful to Linda Tapp for taking time from her busy schedule to encourage me to submit this paper and for initiating the Safety Writers Accountability Group, which provided motivation and accountability during the writing process. I extend my appreciation to the *Professional*

Safety Editorial Review Board for their constructive comments and recommendations, which helped refine the manuscript and enhance the overall presentation. I am deeply grateful to my husband for his steady support, encouragement and patience throughout the development and revision of this work. I also appreciate Veer, whose loyal companionship provided a welcome source of comfort, balance and perspective throughout the writing process.

Disclosure

During the preparation of this article, the author used ChatGPT to help improve clarity, organization, and consistency and to check for errors. The author has reviewed and edited and takes full responsibility for the content, accuracy and originality of the final publication. For updated ASSP AI policy information, see **https://assp.us/AI**.

References

ANSI/ASSP. (2019). Occupational health and safety management systems (ANSI/ASSP Z10.0-2019).

Beschorner, K.E., Pliner, E.M. & Seo, N.J. (2015). Climbing direction, number of contact points and gender influence recovery from ladder falls but not glove use. CDC Stacks. https://stacks.cdc.gov/view/cdc/211877

Gordon, C.C., Blackwell, L.C., Bradtmiller, B., Parham, L.J., Barrientos, P., Paquette, P.S., Corner, D.B., Carson, M.J., Venezia, C.J., Rockwell, M.B., Muncher, M. & Kristensen, S. (2014). 2012 anthropometric survey of U.S. Army personnel (ANSUR II). U.S. Army Natick Soldier Research, Development and Engineering Center.

Hewett, T.E., Myer, G.D., Ford, K.R., Paterno, M.V. & Quatman, C.E. (2016). Mechanisms, prediction and prevention of ACL injuries: Cut risk with three sharpened and validated tools. *Journal of Orthopaedic Research, 34*(11), 1843-1855. https://doi.org/10.1002/jor.23414

Hsiao, H., Simeonov, P., Pizatella, T., Stout, N., McDougall, V. & Weeks, J. (2008). Extension ladder safety: Solutions and knowledge gaps. *International Journal of Industrial Ergonomics, 38*(11-12), 959-965. https://doi.org/10.1016/j.ergon.2008.01.011

International Labour Office. (2009). 10 keys for gender sensitive OSH practice—guidelines for gender mainstreaming in occupational safety and health. www.ilo.org/publications/10-keys-gender-sensitive-osh-practice-%E2%80%93-guidelines-gender-mainstreaming

International Labour Organization (ILO). (n.d.). Gender and occupational safety and health: The big picture. www.ilo.org/topics-and-sectors/safety-and-health-work/gender-and-occupational-safety-and-health

ILO. (2023). Safety and healthy working environments for all: An ILO occupational safety and health policy overview. www.ilo.org/publications/safe-and-healthy-working-environments-all-realizing-fundamental-right-safe

International Organization for Standardization (ISO). (2018). Occupational health and safety management systems—requirements with guidance for use (ISO 45001:2018).

Mathiowetz, V., Kashman, N., Volland, G., Weber, K., Dowe, M. & Rogers, S. (1985). Grip and pinch strength: Normative data for adults. *Archives of Physical Medicine and Rehabilitation, 66*(2), 69-74. https://pubmed.ncbi.nlm.nih.gov/3970660/

National Center for Health Statistics. (2022). Anthropometric reference data for adults: United States, 2015-2018. https://stacks.cdc.gov/view/cdc/100478

NIOSH. (2024). Ladder safety. www.cdc.gov/niosh/falls/ladder/index.html

Onyebeke, L.C., Papazaharias, D.M., Freund, A., Dropkin, J., McCann, M., Sanchez, S.H., Hashim, D., Meyer, J.D., Lucchini, R.G. & Zuckerman, N.C. (2016). Access to properly fitting personal protective equipment for female construction workers. *American Journal of Industrial Medicine, 59*(11), 1032-1040. https://doi.org/10.1002/ajim.22624

OSHA. (n.d.). Ladders (29 CFR 1910). https://osha.gov/laws-regs/regulations/standardnumber/1910/1910.23

OSHA. (2016). Recommended practices for safety and health programs (OSHA Publication No. 3885). www.osha.gov/sites/default/files/publications/OSHA3885.pdf

OSHA. (2023). Commonly used statistics. www.osha.gov/data/commonstats

OSHA. (2024). Personal protective equipment in construction: Final rule (29 CFR Part 1926). www.federalregister.gov/documents/2024/12/12/2024-29220/personal-protective-equipment-in-construction

Pliner, E.M. (2020). Factors contributing to ladder falls and broader impacts on safety and biomechanics [Doctoral dissertation, University of Pittsburgh]. CDC Stacks. https://stacks.cdc.gov/view/cdc/226264

Pliner, E.M., Seo, N.J. & Beschorner, K.E. (2016). Factors affecting fall severity from a ladder: Impact of climbing direction, gloves, gender and adaptation. *Applied Ergonomics, 60*, 163-170. https://doi.org/10.1016/j.apergo.2016.11.011

Pliner, E.M., Sturnieks, D.L., Beschorner, K.E., Redfern, M.S. & Lord, S.R. (2024). Ladder use ability, behavior and exposure by age and gender. *Geriatrics 9*(3), 61. https://doi.org/10.3390/geriatrics9030061

Simeonov, P., Hsiao, H., Armstrong, T., Fu, Q., Woolley, C. & Kau, T.-Y. (2020). Effects of aerial ladder rung spacing on firefighter climbing biomechanics. *Applied Ergonomics, 82*, 102911. https://doi.org/10.1016/j.apergo.2019.102911

Simeonov, P., Hsiao, H., Kim, I.J., Powers, J.R. & Kau, T.Y. (2012). Factors affecting extension ladder angular positioning. *Human Factors, 54*(3), 334-345. https://doi.org/10.1177/0018720812445805

Socias, C.M., Menendez, C.K.C., Collins, J.W. & Simeonov, P. (2014), Occupational ladder fall injuries—United States, 2011. *Morbidity and Mortality Weekly Report, 63*(16), 341-346. www.cdc.gov/mmwr/preview/mmwrhtml/mm6316a2.htm

Trueblood, A.B., Harris, W. & Yohannes, T. (2023). Women in construction: Employment, business owner, and injury trends. Data Bulletin. https://stacks.cdc.gov/view/cdc/128163

U.S. Bureau of Labor Statistics (BLS). (2025). Employed people by detailed industry, sex, race, and Hispanic or Latino ethnicity. www.bls.gov/cps/cpsaat18.htm

U.S. BLS. (2026). Women in the labor force, 2024: Occupation employment profiles of women and men by age. BLS Reports. www.bls.gov/opub/reports/womens-databook/2024/home.htm

Wang, Y.-C., Bohannon, R.W., Li, X., Sindhu, B. & Kapellusch, J. (2018). Hand-grip strength: normative reference values and equations for individuals 18 to 85 years of age residing in the United States. *Journal of Orthopedic and Sports Physical Therapy, 48*(9), 685-693. https://doi.org/10.2519/jospt.2018.7851

Ronilla Ernest, M.P.H., B.D.S., B.Sc., is an industrial hygienist and EHS professional with more than 20 years of experience in both the public and private sectors. She is the founder and principal of the Safety Leader Institute and provides expertise in industrial hygiene, indoor air quality, job safety analysis, exposure assessment, regulatory compliance and safety program development. As a consultant, Ernest has conducted field inspections in governmental, construction, municipal and hospital settings. Ernest earned her Master of Public Health degree in Environmental Health Science with emphasis on Industrial Hygiene from the University of South Carolina. She is also a dentist, having earned a Bachelor of Dental Surgery from Christian Dental College, Ludhiana, Punjab, India. She also holds a Bachelor of Science from SMDRSD College, Pathankot, Punjab, India. Ernest is a member of ASSP's Gulf Coast PLUS Energy Corridor Section. She currently serves as the Professional Development Chair of ASSP's Public Sector Practice Specialty, and has previously served in various roles in the community's leadership. She is the chair of National Safety Council's Women's Division.

Cite this article

Ernest, R. (2026, Nov.). Ladder safety for women workers: Integrating evidence into safety management systems. *Professional Safety, 71*(11), 24-32.