DESIGN DEVELOPMENT RECORD



LIVO supports the journey down to low shelves—and back up again
Everyday independence, within reach

Ain Jeon

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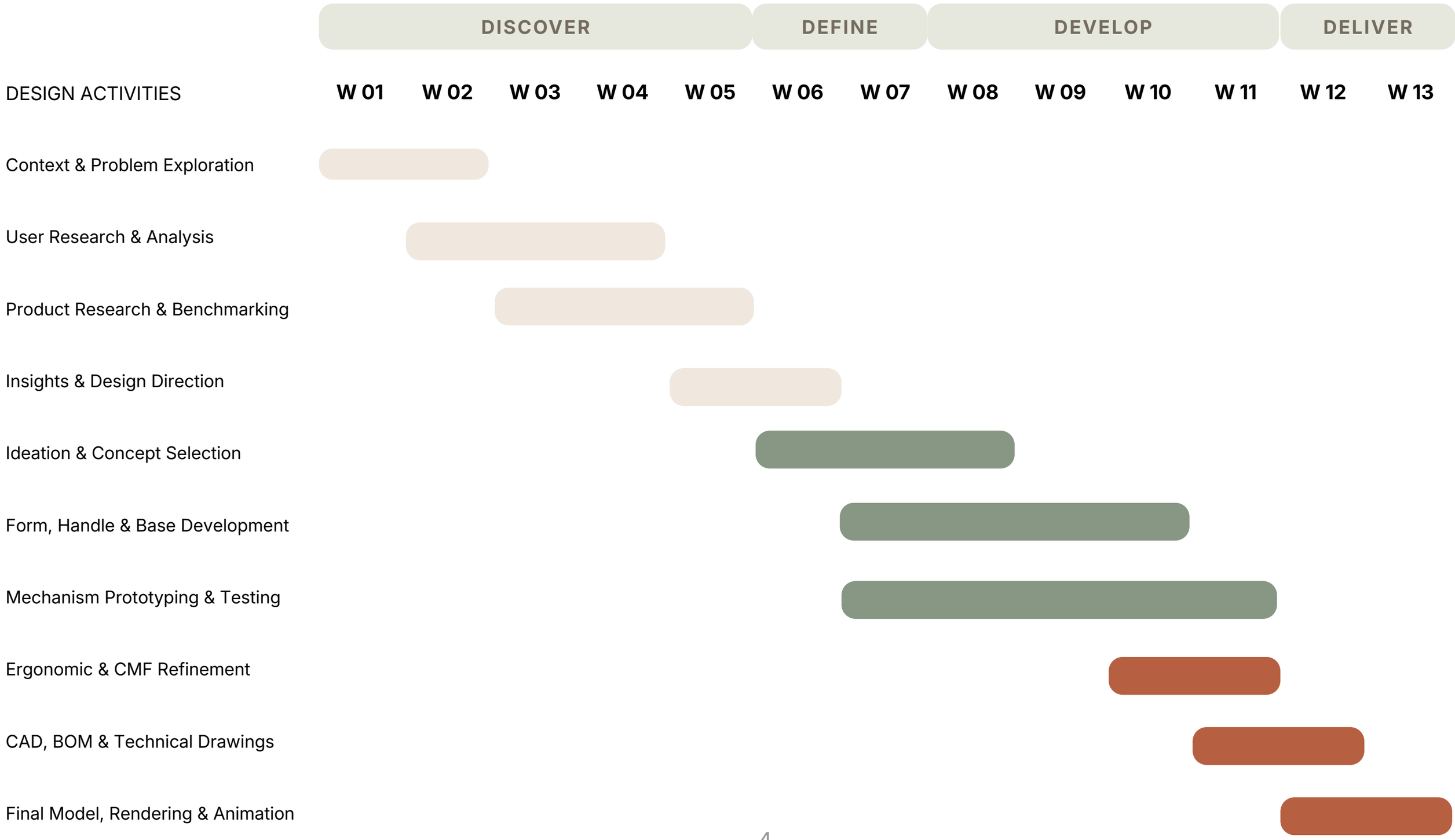
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01

CONTEXT & EXPLORATION

PROJECT GANTT CHART

WEEK 01



SUPPORT INDEPENDENT LIVING

What is Independent Living?

Independent living is the ability to carry out everyday activities safely and confidently with minimal assistance. It is influenced by physical capability, the home environment and access to supportive products.

Why is Independent Living Important?

As people age or experience physical limitations, everyday tasks can become more challenging. Industrial design can improve independence by reducing physical barriers and supporting safe daily activities.

Research Focus

Investigate opportunities for product design to improve independent living by reducing physical barriers within the home

KEY DRIVERS

Key factors influencing independent living

Assistive Design

Reducing physical barriers through supportive products

Daily Activities

Supporting everyday household tasks

Physical Capability

Physical abilities required for daily living

Housing Environment

Domestic environments that influence independence

Sources : WHO (2001) · WHO (2025) · AIHW (2026)

SUPPORT INDEPENDENT LIVING

Why Independent Living Matters



Population Ageing (ABS / AIHW)

- Australia is experiencing rapid population ageing
- Around 17% of Australians are aged 65 years or over. (ABS)

> **Key Finding**
>
> Product design can support independent living by reducing physical barriers within everyday household environments



Home Environment (AIHW / WHO)

- The home environment has a significant influence on independent living
- Accessible household spaces support safer and more independent everyday activities



Mobility Limitations

- Reduced mobility affects daily household activities
- Lower back pain and knee pain are among the leading causes of functional limitation



Quality of Life

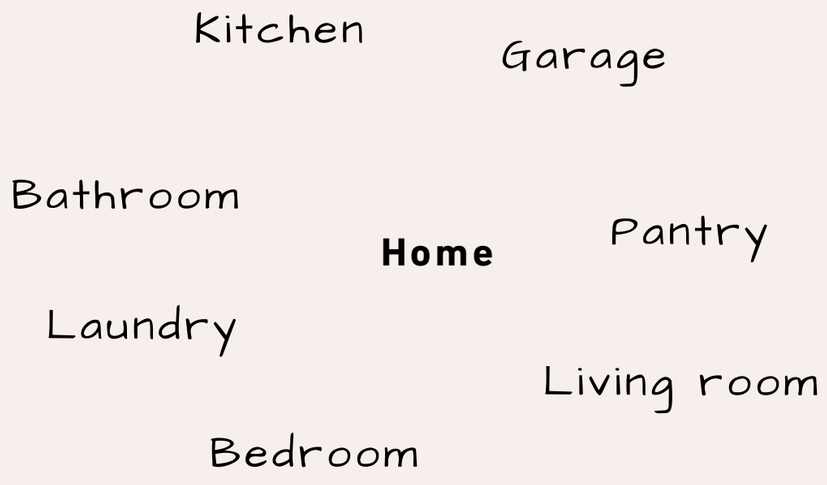
- Maintaining independence improves confidence, dignity, wellbeing, and overall quality of life

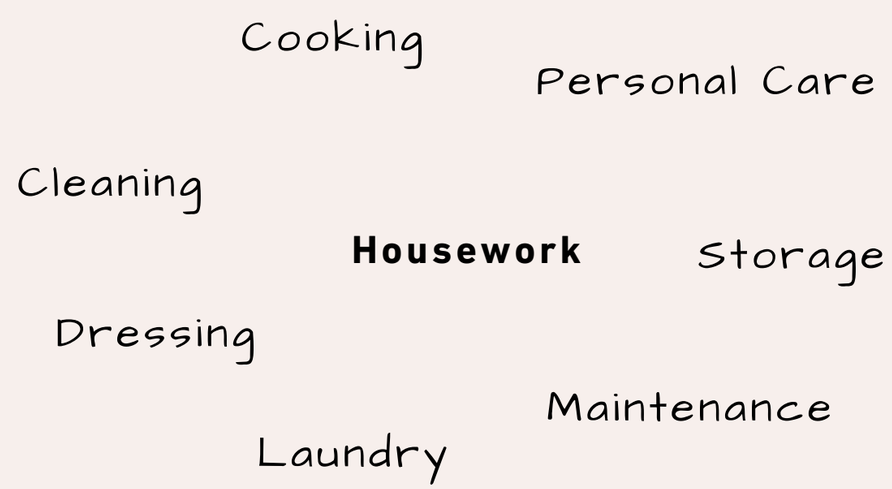


Falls & Injury Prevention (CDC / WHO Falls)

- Physical barriers within the home increase the risk of falls and injuries during everyday activities such as bending, reaching, and lifting

BRAIN DUMP





SUPPORT HUMAN INDEPENDENT LIVING

Emotions

- Frustration
- Fear
- Anxiety
- Loss of independence
- Embarrassment
- Fatigue
- Pain
- Insecurity
- Avoidance
- Reliance on others

People

- Older adults (65+)
- Adults with mobility limitations
- People with reduced muscle strength
- People recovering from injury

Daily Movements

- Bending
- Kneeling
- Reaching
- Stretching
- Twisting
- Carrying
- Standing up

Common problems

- Reaching high places
- Accessing low storage
- Lifting heavy objects
- Maintaining balance
- Carrying household items
- Navigating confined spaces

HOUSEHOLD ACTIVITIES

HOUSEHOLD ACTIVITIES EXPLORATION

Kitchen

- Meal preparation
- Cooking
- Washing dishes
- Pots & pans
- Heavy cookware
- Food containers
- Pantry
- Upper cabinets
- Lower cupboards
- Refrigerator
- Freezer
- Dishwasher

1. **Frequently used items**
2. **Need to reach overhead?**

Bathroom

- Shampoo
- Soap
- Towels
- Toilet paper
- Toothbrush
- Hair dryer
- Medicine
- Skincare
- First aid kit
- Under-sink cabinet
- Mirror cabinet

1. **Small items stored out of reach**
2. **Bending to access under sink**

Laundry

- Washing machine
- Dryer
- Laundry basket
- Hanging clothes
- Folding clothes
- Ironing
- Wardrobe
- Laundry cabinet
- Shoes
- Bedding
- Towels

1. **Heavy laundry basket**
2. **Repeated bending**

Cleaning

- Vacuuming
- Mopping
- Dusting
- Bathroom cleaning
- Window cleaning
- Wiping benches
- Picking things up
- Under furniture
- Carrying bucket
- Cleaning products
- Garbage bin
- Cleaning cupboard

1. **Frequently reaching & bending**

Bedroom

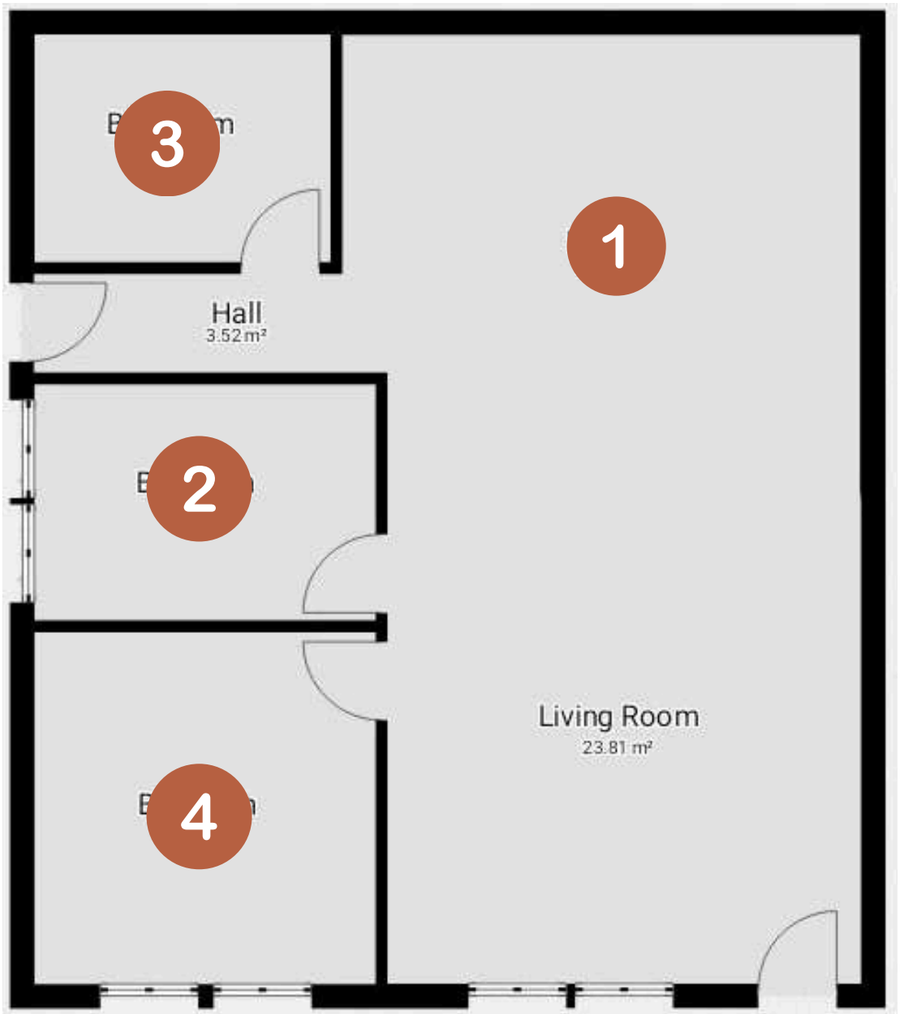
- Wardrobe
- Chest of drawers
- Bedside table
- Under-bed storage
- Bedding
- Pillows
- Shoes
- Clothing
- Accessories

1. **Bending to access lower storage**
2. **Reaching overhead in wardrobes**

Key Observation

Storage accessibility challenges were consistently identified across multiple household activities and rooms, indicating that they are not isolated issues but recurring patterns within the home

HOUSEHOLD ACTIVITIES



Activity Pattern Analysis

	Environment	Typical Activities	Common Storage	Common Access Movements
1	Kitchen	Cooking	Pantry, Upper & Lower Cabinets	Reach / Bend
2	Bathroom	Personal Care	Mirror Cabinet, Under-sink Cabinet	Reach / Bend / Kneeling
3	Laundry	Washing Clothes	Laundry Cabinet, Wardrobe	Bend / Lift
4	Bedroom	Dressing & Storage	Wardrobe, Chest of Drawers, Under-bed Storage	Reach / Bend / Kneeling

Key Observations

- Storage is accessed across multiple rooms
- Storage is involved in many everyday household activities
- Storage interaction occurs repeatedly throughout the day
- Accessibility challenges are consistent regardless of room

ACCESSIBILITY PRINCIPLES

ACCESSIBILITY PRINCIPLES



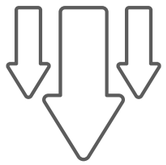
Equitable Use

Products should be usable by people with a wide range of abilities without requiring specialised adaptations



Simple & Intuitive Use

Products should be easy to understand and operate regardless of age or experience



Low Physical Effort

Products should minimise unnecessary bending, reaching, lifting and force during everyday use



Safety & Comfort

Reduce the risk of injury and promote comfortable interaction during daily activities

DESIGN CONSIDERATIONS

Accessibility Principle	Design Consideration
Equitable Use	Accommodate diverse user abilities
Low Physical Effort	Reduce physical demand
Simple & Intuitive Use	Minimise learning and operation complexity
Safety & Comfort	Reduce injury risk and improve comfort

Key Finding

Accessibility is achieved by reducing environmental barriers rather than increasing user capability. These principles establish the foundation for inclusive household product design.

HIGH STORAGE ANALYSIS

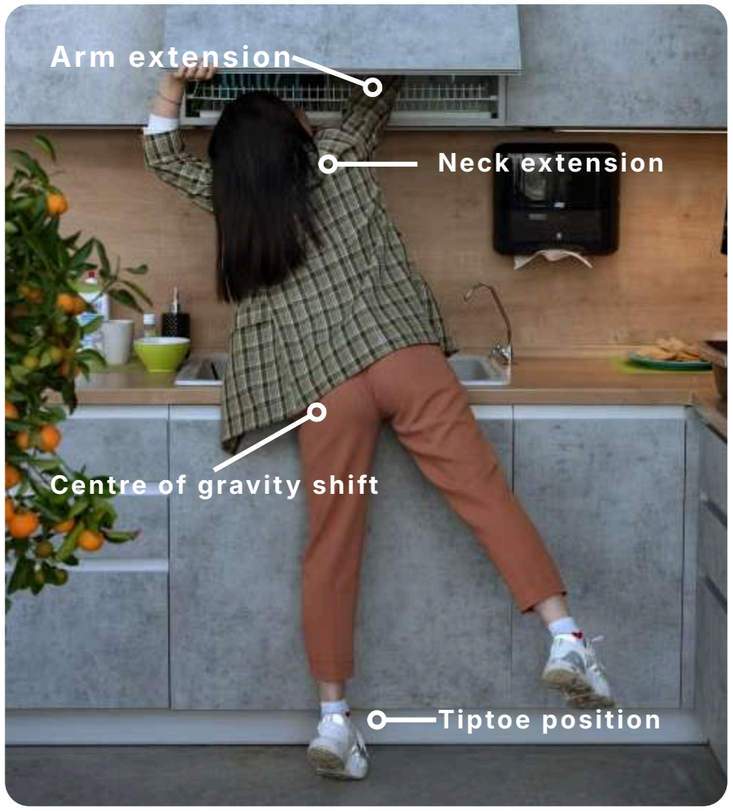
OVERVIEW

High household storage is widely used throughout the home to maximise available space. However, accessing these areas often requires users to reach above shoulder height, increasing physical effort, educing stability while retrieving objects





HUMAN MOVEMENT ANALYSIS



PHYSICAL CHALLENGES

Overhead Reaching

Requires the arms to extend above shoulder height

Reduced Stability

Standing on tiptoes or reaching forward decreases balance

Limited Visibility

Objects stored above eye level are more difficult to identify and retrieve

Heavy Object Handling

Handling heavy items overhead places greater strain on the shoulders and upper body

LOW STORAGE ANALYSIS

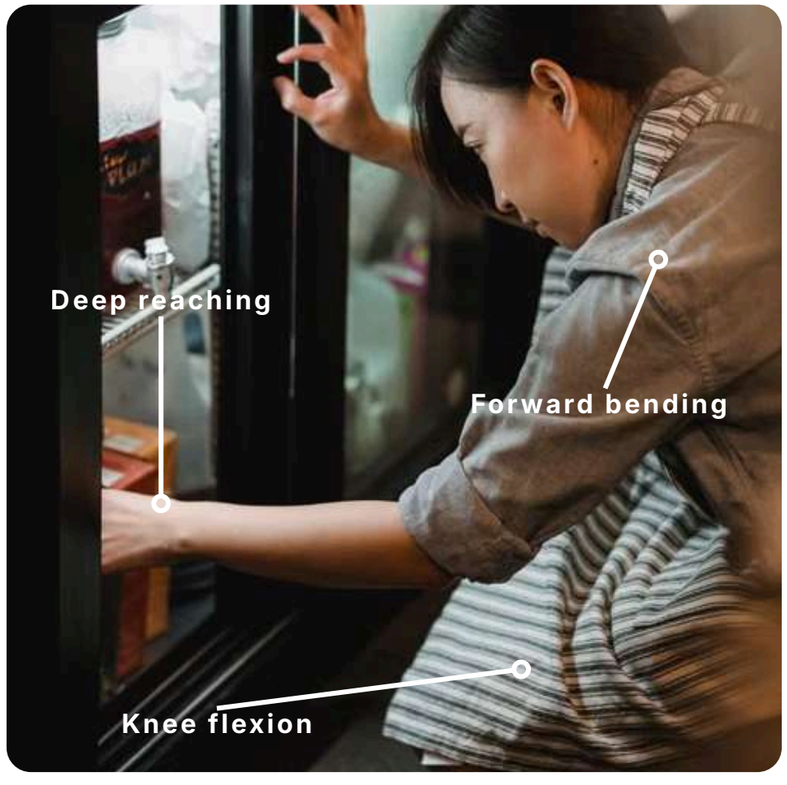
OVERVIEW

Low household storage is commonly used for everyday items such as cookware, cleaning supplies, and pantry products. However, accessing these areas often requires users to bend, kneel, or crouch, increasing physical effort and placing additional strain on the lower back and knees during retrieva





HUMAN MOVEMENT ANALYSIS



PHYSICAL CHALLENGES

Bending Posture

Requires users to bend forward, increasing strain on the lower back

Squatting & Kneeling

Accessing low storage often requires kneeling or squatting, placing additional pressure on the knees and lower limbs

Deep Reaching

Objects positioned at the back of cabinets require excessive reaching and awkward body positions

Limited Visibility

Items stored in deep or low cabinets are more difficult to see and retrieve

COMPARISON TABLE

	High Storage	Low Storage
Primary Movement	Arm extension	Bending & kneeling
Main Body Area	Shoulders & upper body	Lower back & knees
Balance Requirement	High	Moderate
Deep Reaching	Low	High
Storage Accessibility	Moderate	Difficult
Physical Strain	Moderate	High
Existing Solutions	More established	Less effective
Everyday Frequency	Moderate	High





KEY FINDINGS

High Storage

- Mainly affects upper-body movement
- Multiple commercial solutions already exist

Low Storage

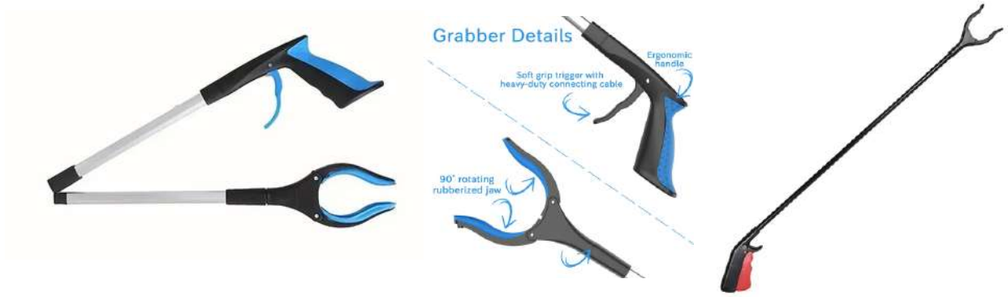
- Frequently used throughout daily activities
- Requires repeated bending and kneeling
- Existing solutions do not fully reduce awkward posture

INITIAL MARKET RESEARCH

Portable Retrieval Tools

Investigate existing products designed to improve access to hard-to-reach household storage

Grabber Tool



Purpose

Retrieve lightweight objects from high or low storage

Advantages

- Portable
- Low cost
- No installation

Limitations

- Limited grip strength
- Unsuitable for heavy objects
- Requires one-handed operation

Hook Retrieval Tool



Purpose

Pull or retrieve hanging or hard-to-reach objects from high or deep storage

Advantages

- Simple construction
- Lightweight and portable
- Reaches deep or overhead storage

Limitations

- Cannot grip objects securely
- Limited to hookable items
- Difficult with heavy or smooth objects

INITIAL MARKET RESEARCH

Accessing High Storage

Investigate products that improve accessibility within fixed household storage

Pull-down Shelf





Purpose

Lower overhead cabinet contents to an accessible height for easier reach

Advantages

- Reduces overhead reaching
- Improves accessibility to high storage
- Supports safer access

Limitations

- Requires permanent installation
- Suitable only for specific cabinets
- Higher cost than portable solutions

Step Stool



Purpose

A platform that elevates the user, allowing safer access to items stored on high shelves

Advantages

- Increases vertical reach
- Simple and inexpensive
- No installation required

Limitations

- Risk of falls or instability
- Requires storage space
- Does not assist users with poor balance or limited mobility

INITIAL MARKET RESEARCH

Accessing Low Storage

Investigate products that improve accessibility within fixed household storage

Pull-out Drawer



Purpose

Bring stored items forward for easier access

Advantages

- Reduces bending and reaching
- Improves visibility of stored items
- Makes deep storage easier to access

Limitations

- Requires cabinet modification
- Fixed to one storage location
- May reduce usable storage space

Tilt-out Cabinet



Purpose

A cabinet system that tilts outward, bringing stored items closer and improving visibility without reaching deep inside

Advantages

- Improves visibility of stored items
- Reduces deep reaching
- Makes access more convenient

Limitations

- Still requires bending to operate
- Limited storage capacity
- Requires permanent installation

EXISTING PRODUCT GAP ANALYSIS

	Portable	Deep Storage	Stable Support	Installation Free	Multi-location	Reduces Bending
Grabber Tool	✓	△	×	✓	✓	△
Hook Retrieval Tool	✓	△	×	✓	✓	△
Pull-down Shelf	×	×	✓	×	×	✓
Step Stool	✓	×	△	✓	✓	×
Pull-out Drawer	×	✓	✓	×	×	△
Tilt-out Cabinet	×	△	✓	×	×	△

✔ = Yes △ = Partial × = No

FINDINGS BY PRODUCT CATEGORY

Portable Tools

Strengths

- Portable and inexpensive
- No permanent installation
- Suitable for multiple locations

Limitations

- Limited support for heavy or irregular objects
- Reduced stability inside deep cabinets
- Often still require bending to reach rear storage

Built-in Storage Systems

Strengths

- Bring stored contents closer to the user
- Improve access to deep storage
- Provide stable object support

Limitations

- Require permanent installation
- Fixed to a single cabinet
- Limited adaptability across different environments

EXISTING PRODUCT GAP ANALYSIS

Objective

Evaluate how existing storage accessibility solutions address low-storage retrieval requirements and identify remaining design gaps

OVERALL GAP

Existing products typically solve either portability or storage accessibility, but rarely both.

Portable retrieval tools provide flexibility but offer limited support and control inside deep cabinets. In contrast, built-in storage systems improve accessibility but require permanent installation and are restricted to a single location.

No existing solution combines:

- Portable use
- Deep low-storage access
- Stable object support
- Installation-free operation
- Compatibility across multiple household environments

Design Insight

Current solutions improve only part of the retrieval process

There is an opportunity to develop a portable retrieval solution that combines the flexibility of handheld tools with the stability and accessibility of built-in storage systems

02

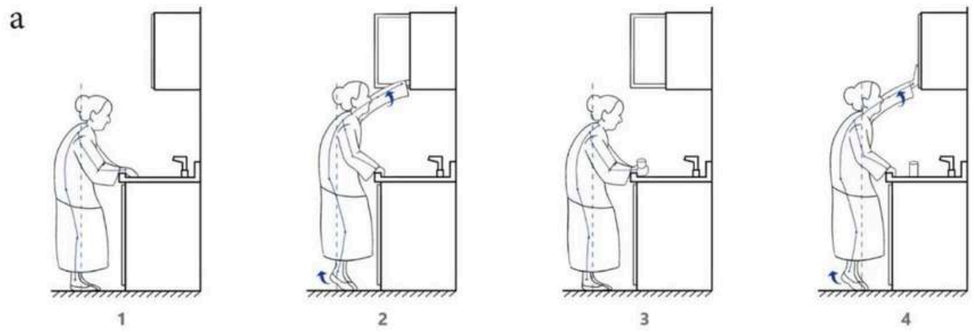
UNDERSTANDING THE PROBLEM

RETRIEVAL STRATEGY ERGONOMICS

COMPARISON

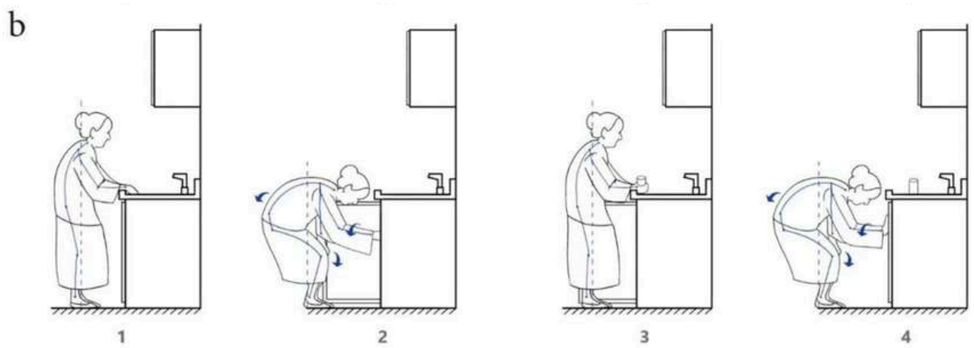
Retrieval Strategy	High Storage	Low Storage
Primary movement	Shoulder flexion	Trunk & knee flexion
Main body region	Shoulder	Lumbar, hip, knee
Centre of gravity	Relatively stable	Moves forward
Physical demand	Upper limb dominant	Whole-body movement
Balance requirement	Moderate	High

HIGH STORAGE



- Greater shoulder elevation
- Upright trunk maintained
- Minimal knee flexion
- Shorter recovery phase

LOW STORAGE



- Increased trunk flexion
- Hip and knee flexion
- Greater forward reach
- Longer recovery movement

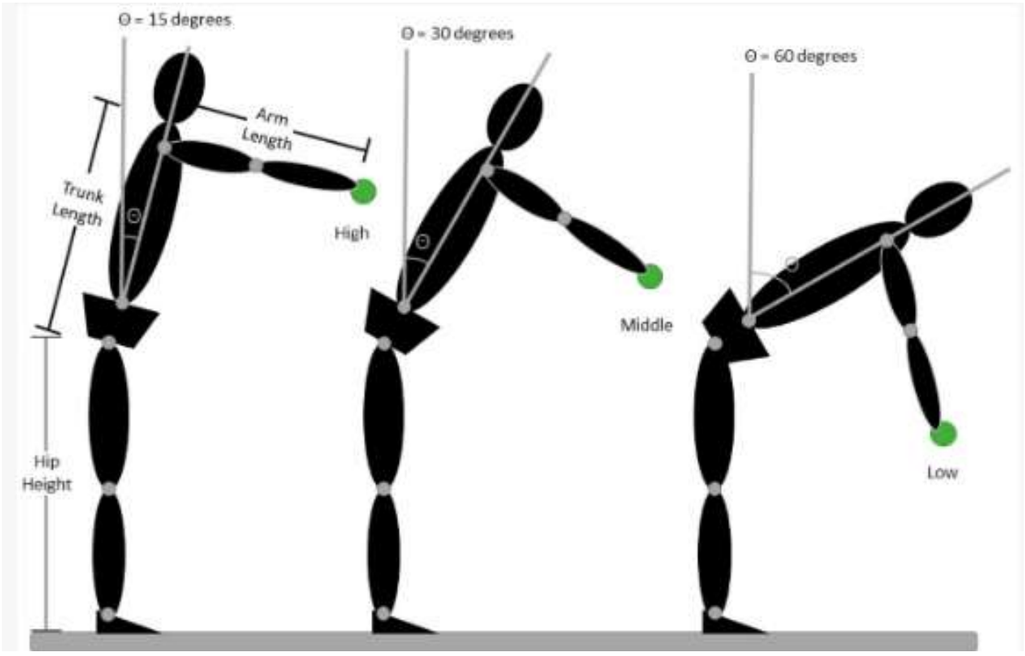
KEY FINDING

Low-storage retrieval requires coordinated movement of the trunk, hips and knees rather than isolated arm movement.

As storage height decreases, whole-body movement becomes increasingly necessary, resulting in greater postural demand.

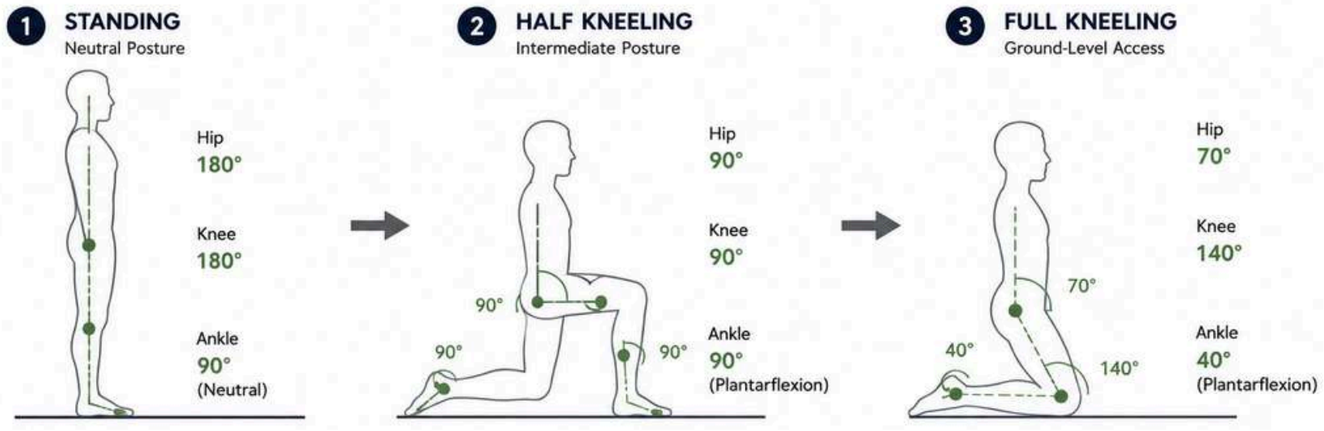
ERGONOMICS OF BENDING & KNEELING

BENDING



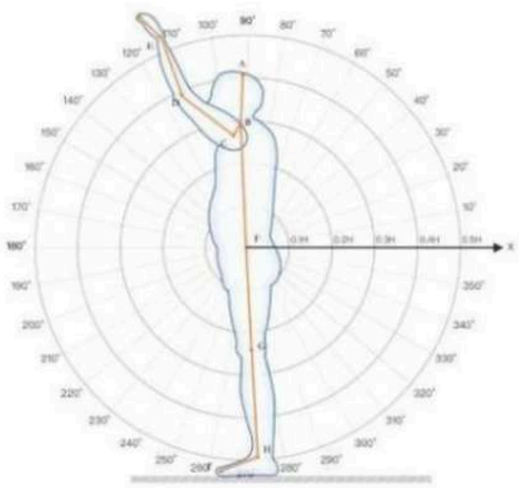
- Forward bending is a coordinated movement involving the lumbar spine, pelvis and hip joints.
- During the early phase of bending, lumbar motion contributes more, while hip motion becomes dominant as the movement continues.
- Increased trunk flexion shifts the body's centre of gravity forward, requiring greater muscular effort to maintain stability.

KNEELING

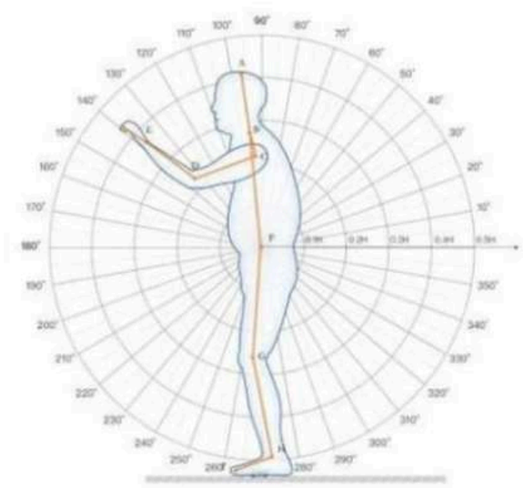


- Kneeling requires substantial knee and hip flexion to reach ground-level objects.
- Body weight is transferred through the knees, increasing local joint loading and reducing mobility.
- Returning to standing requires coordinated extension of the hips, knees and trunk, increasing overall physical demand.

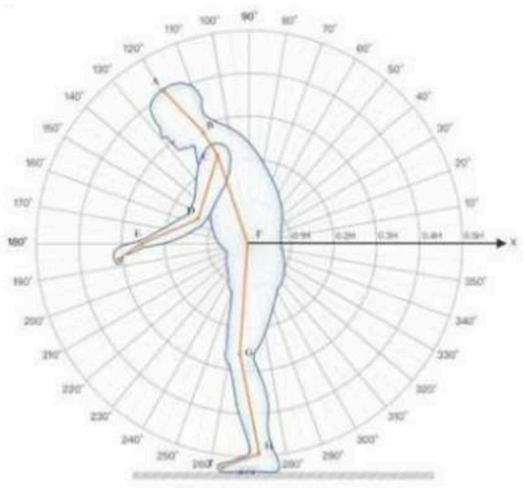
MOVEMENT RANGE ANALYSIS



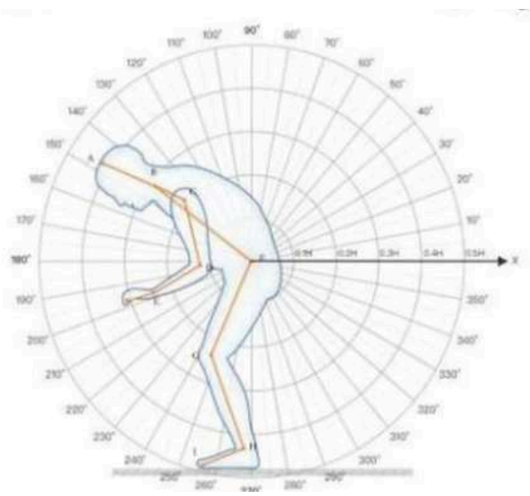
STAGE 1



STAGE 2



STAGE 3



STAGE 4

PROGRESSIVE BODY ADAPTATION

Stage	Dominant Joint	Ergonomic Observation
Stage 1	Shoulder movement	Comfortable reach
Stage 2	Trunk flexion begins	Beginning of trunk flexion
Stage 3	Hip flexion increases	Increased forward inclination
Stage 4	Maximum trunk inclination	Whole-body lowering required

Key Finding

Object retrieval is achieved through a progressive adaptation of multiple joints. When arm reach is no longer sufficient, the body compensates by increasing trunk, hip and knee flexion.

OLDER ADULTS MOVEMENT CHARACTERISTICS

YOUNGER VS OLDER ADULT

Movement Characteristic	Younger Adult	Older Adult
Trunk mobility	Greater ROM	Reduced trunk mobility
Hip & knee flexibility	Greater joint ROM	Reduced joint ROM
Postural transition	Faster	Slower
Balance control	Stable	Reduced stability
Recovery from bending	Lower effort	Higher effort

OLDER ADULT CHARACTERISTIC

Reduced trunk mobility
Less trunk rotation and flexibility reduce bending efficiency.

Reduced lower-limb strength
Lower knee extensor and trunk extensor strength make standing from bending or kneeling more demanding.

Reduced balance confidence
Older adults with lower balance confidence report greater difficulty performing stooping, crouching and kneeling tasks.

Increased physical effort
Everyday movements require greater muscular effort and longer recovery time, increasing fatigue.

Key Finding

Ageing does not simply reduce physical ability; it changes movement performance. Older adults move with reduced mobility, lower strength and decreased balance, making repeated bending and kneeling during low storage access more physically demanding

Design Implication

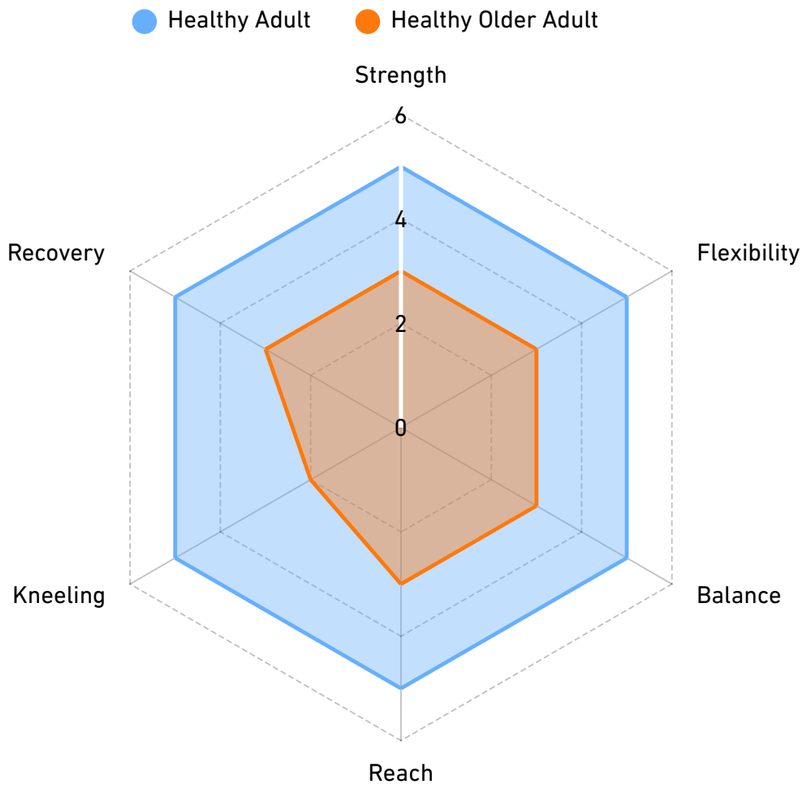
Storage solutions should accommodate age-related changes in movement by reducing the need for deep bending, prolonged kneeling and high lower-limb effort

FUNCTIONAL CAPABILITY COMPARISON

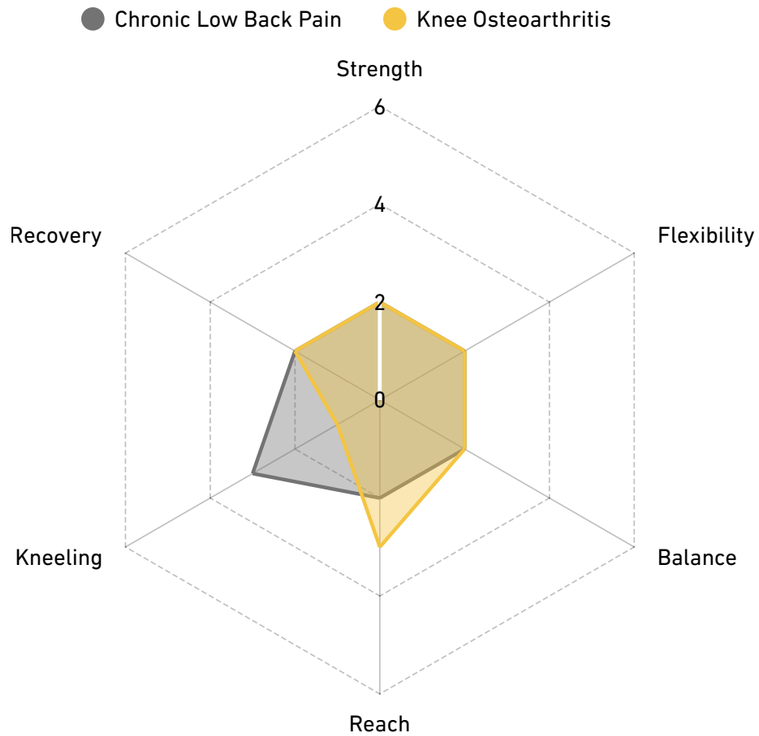
WEEK 03

Evidence-based comparison of functional capabilities relevant to low household storage access

HEALTHY ADULT VS HEALTHY OLDER



CLBP VS KNEE OA



5 - Minimal limitation
4 - Mild
3 - Moderate
2 - High
1 - Severe

*Scores were normalised to a five-point relative capability scale based on evidence synthesised from multiple peer-reviewed studies

Functional Capability Comparison

Scores represent a relative comparison of functional capabilities synthesised from multiple peer-reviewed studies. Higher scores indicate greater capability relevant to low storage access.

Key Finding

Healthy older adults show moderate reductions across all functional capabilities, while chronic low back pain and knee osteoarthritis affect different movement characteristics.

TARGET USER

CANDIDATE USER GROUPS

Healthy Older Adult

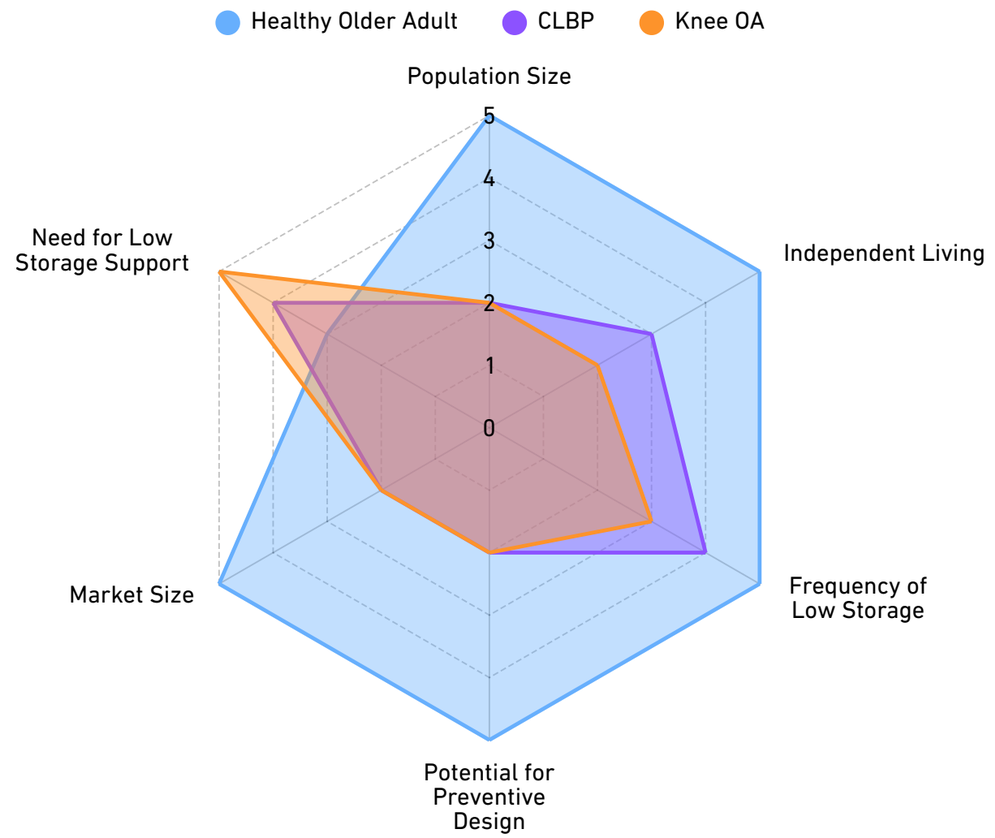
- Mild age-related decline in strength, flexibility and mobility while maintaining independent living

Older Adults with Chronic Low Back Pain (CLBP)

- Reduced trunk mobility and discomfort during bending and prolonged forward flexion

Older Adults with Knee Osteoarthritis (Knee OA)

- Difficulty kneeling, squatting and returning to standing due to knee pain and reduced joint function



SELECTION RATIONALE

Healthy Older

- Largest user population
- Highest proportion of independent living
- Frequent interaction with low household storage

CLBP

- Highly diverse causes of low back pain
- User needs vary considerably
- Existing assistive products mainly focus on symptom management rather than low-storage accessibility

Knee OA

- Strong need for kneeling reduction
- Closely associated with low storage access
- Narrower target population than healthy older adults

TARGET USER

SELECTION RATIONALE

Healthy older adults were selected as the primary target user due to their large population, high level of independent living, and frequent interaction with low household storage. Designing for this group provides the greatest opportunity for preventive intervention while remaining applicable to users with mild chronic low back pain or knee osteoarthritis. (WHO, 2021; AIHW, 2024; Hernandez et al., 2008).

Primary Target User

Healthy Older Adults

Independent older adults experiencing age-related reductions in strength, flexibility and mobility, leading to increasing difficulty accessing low household storage.



User Characteristics

- Living independently
- Mild age-related movement decline
- Frequent low-storage access
- Difficulty accessing low household storage
- No severe mobility impairment

Key Finding

Healthy older adults were selected as the primary target user because they represent the largest independent user group and offer the greatest opportunity for preventive design. The proposed solution may also support users with mild chronic low back pain or early-stage knee osteoarthritis.

RETRIEVAL TASK ANALYSIS

STUDY PURPOSE

Retrieving an object from low household storage is not a single movement. It involves a sequence of visual, postural and manual actions, beginning with identifying the object and ending with returning to an upright position. A 2024 study of older adults retrieving objects from kitchen furniture used motion capture, OpenPose and REBA assessment to examine posture and exertion (Zhou, C., Yu, R., & Kaner, J., 2024). The study found that cabinet height significantly influenced neck, trunk and knee movement, and participants could distinguish retrieval tasks as easy, moderate or strenuous.

RETRIEVAL TASK SEQUENCE

1. Approach and Open

Action:
Move toward the cabinet and open the door or drawer.

Demand:
- Standing balance
- Hand reach
- Clearance around the cabinet opening

2. Lower the Body

Action:
Bend, squat, crouch or kneel to lower the hand toward the stored object.

Demand:
- Trunk flexion
- Hip and knee flexion
- Postural control

3. Reach into Storage

Action:
Extend the arm and trunk toward the object.

Demand:
- Forward reach
- Trunk inclination
- Shoulder extension
- Balance adjustment

4. Secure the Object

Action:
Grip, hook, support or reposition the object before removal.

Demand:
- Hand strength
- Grip accuracy
- Object control
- Visual feedback

5. Move the Object Forward

Action:
Slide, pull or lift the object from the rear of the storage space toward the cabinet opening.

Demand:
- Pulling force
- Sustained trunk posture
- Controlled object movement

6. Lift and Return to Standing

Action:
Lift or carry the object while returning to an upright posture.

Demand:
- Hip and knee extension
- Trunk extension
- Lower-limb strength
- Balance during transition

RETRIEVAL TASK ANALYSIS

TASK DEMAND & INTERVENTION POINTS

Task stage	Main demand	Relative demand	Design relevance
Identify object	Vision and search	Low–Moderate	Improve visibility
Open storage	Reach and clearance	Low	Maintain access space
Lower body	Trunk, hip and knee flexion	High	Reduce required lowering
Reach inward	Forward reach and balance	High	Extend access into depth
Secure object	Grip and control	Moderate–High	Improve object support
Move forward	Pulling and sustained posture	High	Bring objects closer
Return upright	Strength and balance	High	Reduce loaded recovery

CRITICAL INTERVENTION POINTS

Lowering the body

The user must move below their comfortable standing reach

Reaching into cabinet depth

Low height and horizontal depth combine, increasing forward trunk movement

Returning while controlling an object

The user must recover from the posture while carrying or stabilising a load

LOW STORAGE ENVIRONMENTAL CONSTRAINTS

WEEK 03

ENVIRONMENTAL CONSTRAINT MAP

Low-storage difficulty is not determined by height alone. A low cabinet may also be deep, visually obstructed, narrow at the entrance and surrounded by doors, shelves or plumbing. These factors interact and determine how closely the user can approach, how far they must reach and whether an assistive tool can enter and operate effectively. Universal Design guidance states that products and environments should allow a neutral body position, minimise sustained effort and provide suitable space for approach, reach and manipulation (The 7 Principles of Universal Design).

Low Access Height

Condition:
The storage opening is positioned below the user's standing hand level

User effect:
- Requires lowering of the trunk or body
- Increases hip and knee flexion

Internal Obstructions

Condition:
Shelves, pipes, hinges, containers and adjacent objects may obstruct the access path

User effect:
- Requires repositioning or twisting
- Increases the likelihood of knocking nearby objects

Limited Body Clearance

Condition:
The user's legs and feet cannot enter the cabinet space, while doors and surrounding furniture restrict stance

User effect:
- Reliance on bending or one-handed support
- Forces the upper body to compensate for lack of lower-body access



Restricted Opening

Condition:
Cabinet doors, frames, shelves or drawer fronts limit the usable entry space

User effect:
- Restricts shoulder and arm movement
- Prevents direct alignment between user and object
- May require reaching around doors or cabinet edges

Limited Visibility

Condition:
Low viewing angle, poor lighting and objects positioned behind one another reduce visibility

User effect:
- Requires longer visual searching
- Encourages the user to lower the head and trunk
- Makes accurate gripping more difficult

Horizontal Depth

Condition:
Objects may be positioned significantly behind the cabinet opening

User effect:
- Requires forward arm extension
- Encourages additional trunk inclination
- Makes the rear zone harder to inspect

LOW STORAGE ENVIRONMENTAL CONSTRAINTS

WEEK 03

OPERATIONAL CONSTRAINTS

Constraint	Main user consequence	Product challenge
Low height	Body lowering	Downward access
Cabinet depth	Deep forward reach	Long horizontal access
Restricted opening	Limited arm movement	Compact mechanism
Poor visibility	Reduced grip accuracy	Clear alignment/control
Internal obstruction	Indirect access path	Adjustable orientation
Limited body clearance	Unstable posture	External operation

LOW HEIGHT
+
DEEP POSITION
+
LIMITED VISIBILITY
+
RESTRICTED CLEARANCE
↓
GREATER POSTURAL & RETRIEVAL DEMAND

DESIGN RELEVANCE

Compact enough for restricted openings

Capable of changing orientation

Long enough for cabinet depth

Usable without the user entering the storage space

DESIGN OPPORTUNITY

01 USER

Healthy older adults remain independent but experience gradual reductions in strength, flexibility, balance and movement efficiency.

MEANING

The design should provide preventive assistance without appearing clinical or requiring a severe disability.

02 TASK

Low-storage retrieval includes lowering, deep reaching, object control, pulling or lifting and returning to standing.

MEANING

The design should address the whole retrieval sequence, not only increase hand reach.

03 ENVIRONMENT

Low height, horizontal depth, restricted openings and limited visibility combine to increase retrieval difficulty.

MEANING

The product must operate within a constrained cabinet while the user remains outside it.

04 MOVEMENT

The physical burden results from the depth, duration and combination of bending, kneeling, reaching and loaded recovery.

MEANING

The design should reduce movement demand rather than claim to eliminate all body flexion.

05 EXISTING SOLUTIONS

Portable grabbers provide reach but limited support; built-in storage systems provide stable access but require permanent modification.

MEANING

There is space for a portable, installation-free solution with greater stability and deep-storage suitability.

DESIGN OPPORTUNITY

RESEARCH-TO-DESIGN TRANSLATION

Research finding	Design need
Low and deep location increases demand	Extend access downward and inward
User remains bent while searching and gripping	Reduce time spent in lowered posture
Precise gripping is difficult	Use supportive or forgiving engagement
Objects must be moved from the rear	Enable controlled forward translation
Existing stable systems are fixed	Maintain portability
Older adults value independence	Enable simple self-directed use
Cabinet space is restricted	Use a compact or adjustable mechanism
Full elimination of movement is unrealistic	Reduce depth, duration and combined loading

CORE PROBLEM REFRAMING

Initial problem

Older adults experience difficulty accessing low household storage.

Refined problem

The primary challenge is the sustained combination of body lowering, deep reaching and object control required to move items from the rear of low storage into an accessible position.

Emerging need

A method of bringing objects from low and deep storage toward the user before full lifting or loaded postural recovery occurs.

Core Insight

The opportunity is not simply to extend reach. It is to support the controlled transfer of an object from an inaccessible rear zone to an accessible front zone while reducing the user’s postural demand.

MARKET RESEARCH: RETRIEVAL TOOLS

STANDARD REACHER / GRABBER



Mechanism:
Trigger → linkage → claw

Strength:
Simple reach extension / reduces bending and stretching

Limitation:
Limited by jaw size, object geometry and grip stability

REDUCED-GRIP-STRENGTH REACHER



Mechanism:
Low-force trigger → ergonomic handle → rotating claw

Strength:
Reduces finger and wrist demand for users with limited grip strength

Limitation:
Accessible actuation improves usability but does not solve object-control limitations of the claw

LIGHTWEIGHT / REHABILITATION REACHER



Mechanism:
Lightweight shaft → low-force trigger → claw

Strength:
Reduces handling effort and potential upper-limb fatigue

Limitation:
Lightweight construction may trade rigidity / load capacity for easier handling

MULTI-FUNCTION REACHING AID





Mechanism:
Claw + hook/magnet → multiple engagement methods

Strength:
Adapts retrieval to different object characteristics

Limitation:
Each attachment remains object-specific and can increase complexity

DRESSING / DAILY-LIVING EXTENSION TOOL



Mechanism:
Hook → engage → pull

Strength:
Simple, low-force method of bringing an object closer without immediately lifting it

Limitation:
Requires a suitable engagement feature and provides little control over unsupported objects

ASSISTIVE ROBOTICS



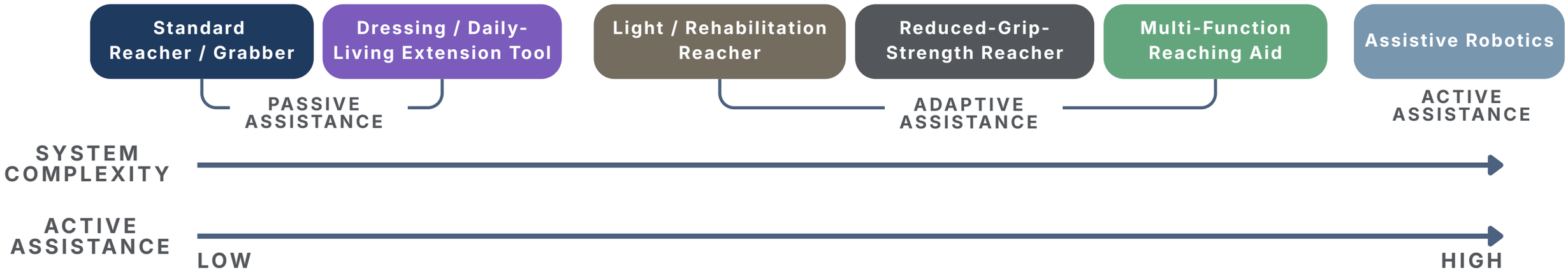
Mechanism:
User sensors → powered arm → gripper → retrieve

Strength:
Provides active reaching, gripping and object transport with minimal physical effort

Limitation:
High complexity, cost and size compared with passive retrieval aids

MECHANISM & USER NEED COMPARISON

ASSISTANCE & COMPLEXITY SPECTRUM



MECHANISM & USER NEED COMPARISON

Mechanism	Reach	Low Grip Demand	Object Variety	Deep Access	Pull / Translate	Lift & Hold	Control
Claw Grip	●●●	●●	●●	●●●	●●	●●	●●
Adaptive Grip	●●●	●●●	●●	●●●	●●	●●	●●●
Hook / Pull	●●●	●●●	●	●●●	●●●	○	●
Multi-Function	●●●	●●	●●●	●●	●●●	●●	●●
Powered / Robotic	●●●	●●●	●●●	●●●	●●●	●●●	●●●

Key Finding

Different mechanisms address different retrieval needs, but trade-offs remain between reach, grip demand, object compatibility and control

DIRECT PRODUCT BENCHMARKETING

01 STANDARD REACHER / GRABBER

A- HELPING HAND CLASSIC PRO REACHER

- Mechanism: Trigger → linkage → non-slip claw
- Length: 660 / 810 mm
- Features: Gripcert jaw, magnetic tip, dressing post, hooked trigger
- Purpose: General floor/high shelf retrieval and dressing. The manufacturer also describes it as being used to reduce bending, stretching, and twisting

B- KCARE REACHER

- Mechanism: Full trigger → swivel jaw
- Construction: Lightweight aluminium + plastic
- Target: Limited mobility / reduced dexterity / difficulty bending and reaching
- Use: Floor, high shelf, hard-to-reach objects

C- ALIMED ALIREACH STANDARD REACHER

- Mechanism: Standard trigger → interlocking jaw
- Length: 26 / 32 in
- Jaw: 3 in opening
- Load: up to 4 lb
- Additional: Magnetic tip + dressing post

02 REDUCED-GRIP-STRENGTH REACHER

A- HELPING HAND ARTHRI-GRIP PRO

- Mechanism: Whole-hand trigger → rotating precision jaw
- Length: 660 / 810 mm
- Key feature: Use all fingers together to distribute the force
- Jaw: 90° rotating
- Target: Arthritis, reduced dexterity, limited hand/wrist strength.

B- SAMMONS PRESTON ADAPT-A-REACHER

- Responds to reduced grip differently from Arthri-Grip.
- Mechanism: Full-fist trigger → suction/rubber jaw
- Length: 26 / 32 in
- Jaw: 3 in, 360° rotating
- Target: Limited dexterity + weak wrist/grip

C- HELPING HAND CLASSIC MAX GEL HANDLE

- Mechanism: Trigger → claw
- Handle: Soft gel-filled grip
- Target: Arthritis, Parkinson's, reduced hand strength
- Purpose: Grip stability and reduced strain when used for a long time

03 LIGHTWEIGHT / REHABILITATION REACHER

A- ETAC AKTIV REACHER

- Weight:

45 cm = 111 g

60 cm = 120 g

70 cm = 128 g

80 cm = 138 g

90 cm = 150 g

- Load: max 2 kg
- Mechanism: Angled ergonomic handle → rubber-coated jaw
- Feature: Small squeeze, index-finger support, two jaw orientations.

B- HELPING HAND FEATHERWEIGHT REACHER

- Target: Older adults, stroke survivors, post-surgery users
- Mechanism: Low-effort trigger → claw
- Purpose: retrieval of everyday objects without bending/twisting/overreaching
- Design emphasis: low tool weight + low trigger effort.

C- HOMECRAFT HANDI-REACHER

- Weight:

61 cm = 180 g

76 cm = 200 g

90 cm = 220 g

- Mechanism: Four-finger trigger → rotating jaw
- Target: Limited mobility, lower-body surgery recovery, limited hand strength
- Feature: 360° rotating head reduces wrist rotation

DIRECT PRODUCT BENCHMARKETING

04 MULTI-FUNCTION REACHING AID

A- ASPIRE PICK UP REACHER

- Mechanisms: Twin gripping jaws
magnetic head
rotatable head
stick clip
- Lengths: 600 / 750 / 900 mm
- Weight: 215 / 235 / 250 g
- Load: ≤454 g
- Target: Short trigger action that also considers stiff/arthritic fingers

B- HOMECRAFT HANDI-REACHER

- Engagement methods:
Contoured claw
magnetic tip
dressing hook
rotating head

C- HEAVY DUTY REACHER

- 870 mm / 400 g / Max load 5 kg
- Reduces discomfort when bending to retrieve items
- Comfortable squeeze lever handle action activates jaw grips
- Strong jaws with rubber suction cups hold objects tight
- Jaws remain open until lever is squeezed
- Rotatable head with lockable jaws

*Adjacent mechanism

05 DRESSING / DAILY-LIVING EXTENSION TOOL

A- AIDACARE DRESSING STICK

- Mechanism: Hook → engage → pull/push
- Length: 520 mm
- Weight: 230 g
- Target: Difficulty bending, reaching or grabbing.

B- REDGUM RG71DS DRESSING STICK

- Mechanism: Dual-prong rubber hook + metal round hook
- Length: 690 mm
- Weight: 70 g
- Purpose: Dressing/removing clothing

C- AIDACARE DELUXE DRESSING STICK

- Mechanism: Long shaft + hook → push/pull/engage fabric
- Length: 26 in (~660 mm)
- Target: Seniors, people recovering from injury/surgery, people with disabilities
- Purpose: Manufacturer specifically describes reducing bending, twisting and reaching

06 ASSISTIVE ROBOTICS

A- KINOVA JACO ASSISTIVE ROBOT

- It is a wheelchair-mounted assistive robot that allows users to move its arms in 3D space to grasp and release objects. According to the manufacturer's documentation, it is described as supporting various ADLs, such as eating, drinking, hygiene, medication, and work/school
- User control → powered 6-axis arm → 3-finger gripper → manipulate/retrieve

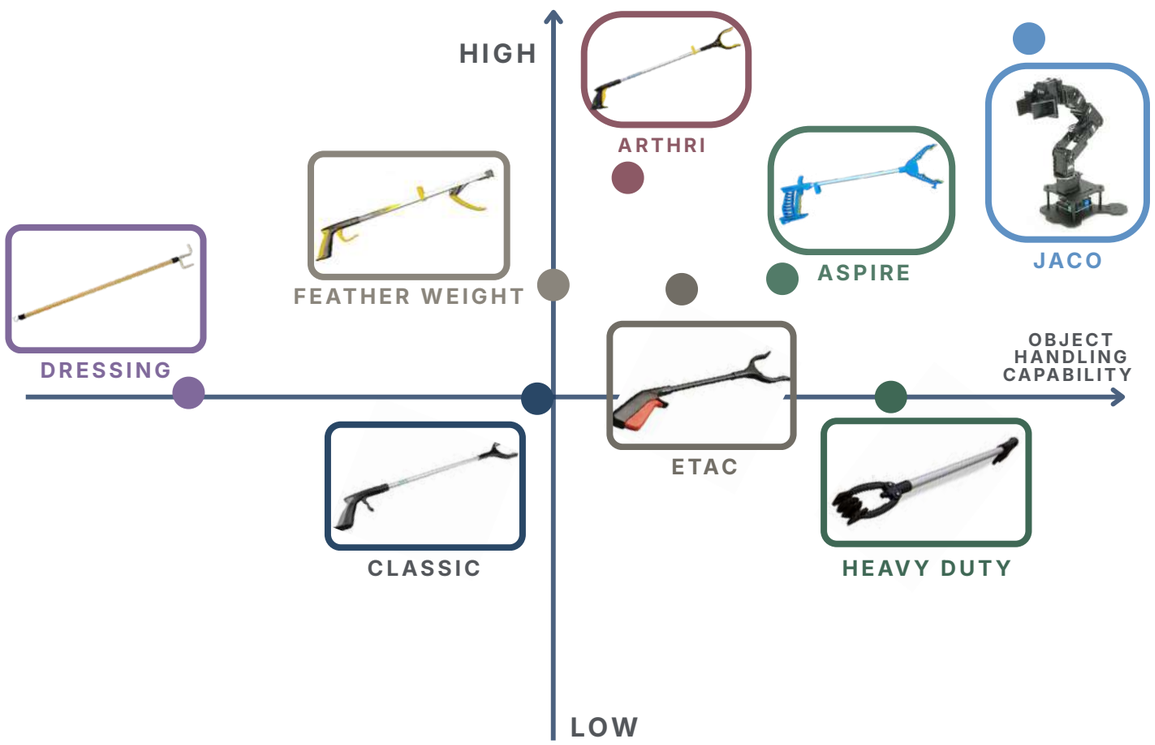
BENCHMARKETING PRODUCT POSITIONING

Product	Weight	Load	Reach	Mechanism	Grip Demand	Object Compatibility	Control
Helping Hand Classic PRO	-	-	660 / 810 mm	Trigger → non-slip claw + magnet	Medium	Medium–High	Medium
Helping Hand Arthri-Grip PRO	-	-	660 / 810 mm	Whole-hand trigger → 90° rotating jaw	Low	Medium–High	High
Etac Aktiv	111–150 g	2 kg max	450–900 mm	Small-squeeze angled handle → rubber jaw	Low	Medium	High
Helping Hand Featherweight	195 / 220 g	-	660 / 810 mm	Low-effort trigger → single moving jaw	Low	Medium	Medium–High
Aspire Pick Up Reacher	215–250 g	454 g max	600 / 750 / 900 mm	Twin jaws + magnet + rotating head	Low–Medium	High	High
Redgum Heavy Duty RGM36HD	400 g	5 kg max	870 mm	Squeeze lever → suction jaws + locking/rotation	Medium–High	High	High
Aidacare Dressing Stick	230 g	-	520 mm	Passive hook → pull/push	Low	Low	Low–Medium
Kinova JACO	5.2 kg system	1.3 kg / 1.6 kg	Powered articulated arm	Powered 6-axis arm + 3-finger gripper	Very Low	Very High	Very High

DIRECT BENCHMARKING COMPARISON

NORMALIZATION EVALUATION

Product	Physical Effort Reduction	Object Handling Capability
Dressing Stick	3	1
Classic PRO	3	3
Featherweight	4	3
Etac Aktiv	4	3.5
Arthri-Grip PRO	4.5	3.5
Aspire Pick Up	4	4
Redgum Heavy Duty	3	4.5
JACO	5	5



Y — PHYSICAL EFFORT REDUCTION

- grip effort
- tool handling weight
- body movement/reach assistance
- powered assistance

X — OBJECT HANDLING CAPABILITY

- load capacity
- object variety
- gripping/engagement methods
- positioning/control capability

Key Finding

Existing products tend to prioritize either reduced physical effort or greater object-handling capability. Passive tools show clear trade-offs between lightweight/easy operation, object versatility and load capacity, while JACO achieves high assistance through a powered system

BENCHMARKING FINDINGS & MARKET GAP

01 REACH IS WELL ADDRESSED

Most products successfully extend the user's reach, allowing objects to be accessed without moving the body directly toward them

Finding:
Reach extension = mature solution

02 PHYSICAL EFFORT IS REDUCED IN DIFFERENT WAYS

Adaptive grips and lightweight designs reduce hand or tool-handling effort, but these benefits are usually addressed separately

Finding:
Assistance is often specialised

03 OBJECT HANDLING CREATES TRADE-OFFS

Greater object versatility or load capacity often requires additional mechanisms, larger jaws or heavier construction

Finding:
Versatility ↔ simplicity

04 SIMPLE TOOLS STILL RELY ON REMOTE CONTROL

Passive reachers reduce the need to move toward an object, but the user still needs to position, engage and control the object through the tool

Finding:
Less body movement / no user effort

MARKET GAP

EXISTING MARKET

Extend Reach

↓

Reduce grip effort / Reduce weight / Increase load / Increase versatility

Gap Finding

No simple passive product in the reviewed sample combined high physical assistance with high object-handling capability

Existing products mainly focus on bringing the object to the user. This leaves an opportunity to explore whether low-level access could be supported through other forms of physical assistance

03

USER RESEARCH & INSIGHTS

VIDEO OBSERVATION RESEARCH

Purpose of observation

Investigate actual retrieval behavior by observing the posture, movement processes, storage environment, and object characteristics that occur when retrieving items from low household storage spaces

RESEARCH QUESTION

What physical movement requirements arise when retrieving low-height objects, and how are these requirements influenced by the user's ability, storage conditions, and assistive tools?

REPORT METHODOLOGY

Structured video observations were performed using publicly available online videos. The videos were intentionally selected based on three categories: user movement, interactions with limited storage space, and the use of portable retrieval aids. Observable behaviors were coded using a predefined framework encompassing posture, reach, object interaction, environmental conditions, use of aids, and recovery movements

INCLUSION CRITERIA

- Clear relevance to low-level movement or retrieval
- Relevant body movement or assistive interaction clearly visible
- Sufficient visual information for coding
- Relevant to older adults, physical limitations, low storage or retrieval assistance

EXCLUSION CRITERIA

- Only hands/objects visible
- Movement obscured by cabinets/objects
- No action of actually taking out an object
- Storage only in high places/overhead
- Promotional videos showing only product close-ups
- Repeated footage that did not provide additional observable behaviour

VIDEO OBSERVATION RESEARCH

CATEGORY A — OLDER / PHYSICALLY LIMITED USER MOVEMENT

RQ1 — USER

How do older adults or people with physical limitations lower, reach and recover during low-level tasks?

SELECTED VIDEOS

V01	**4 See and Hear In the kitchen**	Older adult's bending, knee movement, reaching, functional kitchen movement	(iLA. 2021)
V02	**Berg Balance Scale — Picking Object From Floor**	Older adult's standing → lowering → floor reach → pickup → rising/recovery	(StopFalls.org, 2013)
V03	**PBS — Active Elders: At Home, But Not Forgotten**	Standing → Hands supported on chair → Knee flexion → One-knee kneeling → Two-knee / all-fours position → Floor position → Floor → standing recovery	(WQLN PBS, 2021)

VIDEO OBSERVATION RESEARCH

CATEGORY A — OLDER / PHYSICALLY LIMITED USER MOVEMENT

V01 - 4 SEE AND HEAR IN THE KITCHEN

Older adult's bending, knee movement, reaching, functional kitchen movement

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V01-01	~0:23–0:30	Reaching down to retrieve a cup/item from a lower position	Clear forward trunk flexion	Not visible — cannot code	Downward reach	-	Returns toward upright	Stand → bend → reach → retrieve → rise	**Shows forward trunk bending during low-level retrieval, although lower-body movement could not be assessed due to camera framing**
V01-02	~0:31–0:35	Accessing a lower storage/appliance area	Forward trunk flexion while looking/reaching downward	Lower body partially visible; exact knee posture unclear	Downward / inward reach	-	Returns toward upright	Stand → bend/look down → reach → interact → rise	**Shows how visual access and physical reaching can occur together when accessing a low position**
V01-03	~2:20–2:31	Opening and accessing a low drawer	Moderate forward trunk flexion	Standing maintained; slight lower-body adjustment visible, no kneeling observed	Downward reach into drawer	-	Returns toward upright standing	Stand → open → bend → look/reach → interact → rise	**Shows low-drawer access being performed mainly through trunk bending while maintaining a standing posture**

PRELIMINARY OBSERVATION

In the selected low-position interactions, the participants were repeatedly observed leaning their upper bodies forward while generally maintaining a standing posture. No clear kneeling was observed. However, in some scenes, the knees were positioned outside the camera frame, making it impossible to determine the lower body posture

VIDEO OBSERVATION RESEARCH

CATEGORY A — OLDER / PHYSICALLY LIMITED USER MOVEMENT

V02 - BERG BALANCE SCALE — PICKING OBJECT FROM FLOOR

Older adult's standing → lowering → floor reach → pickup → rising/recovery

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V02-01	9:35 - 10:0	Picking up objects from the floor	Forward trunk flexion with one hand placed on the floor	Standing posture with knees slightly bent	Downward reach to floor level	One hand placed on floor	Slow return to upright standing	Stand → bend → reach/support → retrieve → gradual rise	**The motion of picking up objects was performed primarily by bending the torso rather than significantly bending the knees. The user also utilized the floor to support the upper body during the task**

PRELIMINARY OBSERVATION

During the process of retrieving an object at floor height, a large forward bend of the upper body was observed along with relatively little knee bending. The user supported their body by placing their hands on the floor, and after retrieving the object, slowly returned to a standing position

VIDEO OBSERVATION RESEARCH

CATEGORY A — OLDER / PHYSICALLY LIMITED USER MOVEMENT

V03 - PBS — ACTIVE ELDERS: AT HOME, BUT NOT FORGOTTEN

PBS — Active Elders: At Home, But Not Forgotten

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V03-01	19:45–19:55	Lowering your body from the chair toward the floor	Forward trunk flexion while transferring body weight downward	Progressive knee flexion → one knee lowered toward floor	-	Chair	-	Sit/stand → chair support → knee flexion → one-knee lowering → floor position	**Shows the use of external support during controlled lowering to the floor**
V03-02	19:55–20:17	Rising from floor to standing	Forward trunk position during initial rise, followed by gradual trunk extension	Floor/kneeling position → one knee raised → progressive knee extension	-	Chair	Supported, staged return to standing	Floor → chair support → one-knee position → push upward → gradual rise → stand	**Shows that recovery from a low position occurs as a staged movement, with the chair providing external support during the transition to standing**

PRELIMINARY OBSERVATION

The user relied on external support during both lowering and rising. Returning from the floor occurred through a staged transition involving kneeling, chair support and gradual knee and trunk extension rather than a single direct movement

VIDEO OBSERVATION RESEARCH

CATEGORY B — LOW STORAGE INTERACTION

RQ2 — TASK

What combinations of trunk, knee and reaching movements occur during low-storage access?

VEDIO LINK

V04	**Entire House Speed Cleaning 2020 — Alexandra Beuter**	Repetitive bending/squatting in low-level household tasks	(Beuter, 2019
V05	**Whole House Deep Clean With Me — The Mom Resource**	Repeated bending, sitting/lowered posture, reaching, recovery	(The Mom Resource, 2025)
V06	**Elderly Woman Searching in Low Kitchen Cabinet**	Standing → Body lowering → Trunk bending → Looking/searching inside low cabinet → Reaching	(ShotHappens, n.d)

VIDEO OBSERVATION RESEARCH

CATEGORY B — LOW STORAGE INTERACTION

V04 - ENTIRE HOUSE SPEED CLEANING 2020 — ALEXANDRA BEUTER

Repetitive bending/squatting in low-level household tasks

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V04-01	2:38 - 2:44	Retrieving an item from a very low shelf	Deep forward trunk flexion while reaching into the shelf	Kneeling on the floor	Deep reach toward the back of the shelf	-	Returns to standing	Lower body → kneel → deep forward reach → retrieve item → return to standing	**Accessing a very low shelf required combined kneeling, deep trunk flexion and extended reach, demonstrating the substantial postural demand created by low and deep storage**
V04-02	12:44 - 13:47	Loading a dishwasher	Repeated slight forward trunk flexion while loading items	Remains standing	Repeated downward reach between sink and dishwasher	-	Returns to upright posture repeatedly	Slight bend → retrieve item → reach downward → load dishwasher → return upright → repeat	**The repeated loading task required recurring trunk flexion and downward reaching despite the user remaining standing, indicating cumulative movement demand during repeated low-level access**
V04-03	15:40 - 16:00	Retrieving an item from a very low shelf	Deep forward trunk flexion while reaching into the shelf	Kneeling on the floor	Extended reach into the shelf	One hand placed on the floor for support	Returns to standing	Lower body → kneel → use hand support → reach → retrieve item → return to standing	**Hand-to-floor support was added during deep low-level retrieval, showing how external support may be incorporated when accessing very low storage**

PRELIMINARY OBSERVATION

Very low shelf access involved a combination of kneeling, deep trunk flexion and extended reaching, with hand support used in one interaction. Dishwasher loading required less extreme postural lowering but involved repeated trunk flexion and downward reaching while standing

VIDEO OBSERVATION RESEARCH

CATEGORY B — LOW STORAGE INTERACTION

V05 - WHOLE HOUSE DEEP CLEAN WITH ME — THE MOM RESOURCE

Repeated bending, sitting/lowered posture, reaching, recovery

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V05-01	5:17 - 5:49	Cleaning inside an oven	Deep forward trunk flexion with the upper body maintained in a low position	Kneeling	Deep reach into the oven, up to shoulder level	One hand holding the oven handle	Returns to standing	Open oven → kneel → bend forward → hold handle → reach inside → return to standing	**Accessing the low oven involved kneeling, deep trunk flexion and extended reaching, deep trunk flexion and extended reach, with the oven handle used for additional support.**
V05-02	9:09 - 9:16	Cleaning a low drawer	Forward trunk flexion toward the drawer	Kneeling	Reach into the drawer	One hand supported on the countertop	Returns to standing	Turn → kneel → bend/reach → clean → rise	**The user combined kneeling with trunk flexion and countertop support to access the low drawer**
V05-03	9:20 - 9:24	Cleaning a low drawer	Deep forward trunk flexion while remaining standing	Standing with limited visible knee flexion	Downward reach toward the low drawer	One hand supported on the countertop	-	Stand → brace on countertop → deep bend → reach downward	**The user accessed the same low area from standing by using substantial trunk flexion and external support instead of kneeling**

PRELIMINARY OBSERVATION

The same low-level task was approached using different postures, including kneeling and deep forward bending from standing
External support was used in all three interactions, suggesting that low-level access can involve both substantial body lowering and additional support depending on the posture used

VIDEO OBSERVATION RESEARCH

CATEGORY B — LOW STORAGE INTERACTION

V06 - ELDERLY WOMAN SEARCHING IN LOW KITCHEN CABINET

Standing → Body lowering → Trunk bending → Looking/searching inside low cabinet → Reaching

MASTER CODING TABLE

ID	Time	Observed task	Trunk / Body	Knee posture	Reach	Support	Recovery	Movement sequence	Research relevance
V06-01	0:00–0:20	Opening and searching inside a low kitchen drawer	Sustained forward trunk flexion, becoming deeper while looking and reaching into the drawer	Standing with slight knee flexion	Downward and inward reach into the drawer	-	Recovery to upright is not clearly shown within the clip	Approach → bend → open drawer → bend further → look inside → reach/search	**The user remains standing and relies mainly on sustained trunk flexion to access and visually search a low drawer. Trunk flexion increased as the user looked and reached further into the drawer.**

PRELIMINARY OBSERVATION

The user maintained a standing position throughout the task and relied mainly on forward trunk flexion to access the low drawer Trunk flexion increased while visually searching and reaching further inside, while knee movement remained relatively limited

VIDEO OBSERVATION RESEARCH

CATEGORY C — PORTABLE RETRIEVAL AIDS IN USE

RQ3 — TOOL

How do portable retrieval aids alter or reduce these movements?

VEDIO LINK

V07	**Reacher/Grabber for Quad Hands — Active Hands**	Wrist flexion instead of finger trigger, object pickup process	(The Active Hands Company, 2017)
V08	**Easireach Reacher - Available In 4 Different Lengths**	Low-level object pickup in standing/seated state, replace bending with reach extension.	(Complete Care Shop, 2020)
V09 - Product / expert demonstration	**Approved Reacher Tool That Makes Daily Life Easier**	Reduced bending/twisting when picking up floor objects, maintaining a standing posture, or using a reacher	(AskSAMIE, 2025)

VIDEO OBSERVATION RESEARCH

CATEGORY C — PORTABLE RETRIEVAL AIDS IN USE

V07 - REACHER/GRABBER FOR QUAD HANDS — ACTIVE HANDS

Wrist flexion instead of finger trigger, object pickup process

MASTER CODING TABLE

ID	Time	Task / Object	User Posture	Tool Interaction	Reach / Access	Body Lowering	Object Control	Movement Sequence	Research relevance
V07-01	1:15–1:22	Retrieving a small object from the floor	Seated in wheelchair with relatively upright trunk posture	Hand-operated reacher, jaw positioned around the object and closed using the handle control	Tool extends from seated hand position to floor level	Minimal body lowering observed	Remote grip → lift → bring object toward user	Remain seated → extend tool downward → position jaw → grip object → lift → retrieve	**The reacher allows a floor-level object to be retrieved without the user lowering their body to the floor. However, accurate positioning and remote gripping are still required to engage the object**
V07-02	2:01–2:14	Reaching and interacting with an item above seated reach height	Seated with slight upper-body extension toward the target	Reacher extended upward and controlled from the handle	Extends access beyond normal arm reach	-	Tool tip/jaw used to engage the elevated item	Remain seated → raise tool → position tool → engage item → manipulate/retrieve	**The tool extends the user's functional reach while remaining seated, showing that reach extension can address both low and high access without requiring major changes in body position**

PRELIMINARY OBSERVATION

With the Reacher, users could access the floor and objects at high positions while maintaining a seated posture. In particular, when retrieving objects from the floor, there was no need to lower the body significantly. However, to grasp the object, the tip of the tool had to be precisely positioned and manipulated from a distance

VIDEO OBSERVATION RESEARCH

CATEGORY C — PORTABLE RETRIEVAL AIDS IN USE

V08 - EASIREACH REACHER - AVAILABLE IN 4 DIFFERENT LENGTHS

Low-level object pickup in standing/seated state, replace bending with reach extension

MASTER CODING TABLE

ID	Time	Task / Object	User Posture	Tool Interaction	Reach / Access	Body Lowering	Object Control	Movement Sequence	Research relevance
V08-01	0:11 – 0:16	Picking up a small metallic object from the floor	Standing upright	Magnetic tip used to engage the object	Floor-level access	No substantial body lowering observed	Magnetic contact → lift object	Stand → lower tool → magnetic engagement → lift → retrieve	**The magnetic attachment simplifies retrieval of a compatible small object without requiring precise gripping at floor level**
V08-02	0:18 – 0:27	Retrieving an object from the floor while seated	Seated in a chair	Reacher extended downward from the seated position	Floor-level access from seated position	No transition to a lower body position required	Position tool → engage object → lift → bring toward body	Remain seated → extend tool → engage object → lift → retrieve	**The reacher extends floor-level access from a seated position without requiring the user to stand, kneel or move down to the object**

PRELIMINARY OBSERVATION

Using the Reacher allowed access to objects on the floor without significantly lowering the body, even while standing or sitting. Magnetic pickup was used in addition to standard gripping, demonstrating that the required manipulation method at the tip of the tool can vary depending on how it engages with the object

VIDEO OBSERVATION RESEARCH

CATEGORY C — PORTABLE RETRIEVAL AIDS IN USE

V09 - APPROVED REACHER TOOL THAT MAKES DAILY LIFE EASIER

Reduced bending/twisting when picking up floor objects, maintaining a standing posture, or using a reacher

PRODUCT DEMONSTRATION CODING TABLE

ID	Time	Demonstrated Feature	Intended Use / Problem	Tool Interaction	Reach / Access	Physical Demand Addressed	Limitation / Consideration	Research relevance
V09-01	0:20–0:35	Reacher / grabber introduced as an assistive tool	Retrieving objects that would otherwise require the user to change body position	Hand-operated reacher with remote gripping end	Extends functional reach beyond the hand	Presented as reducing the need for bending and twisting	**Actual change in user posture cannot be observed because no retrieval task is performed**	**Provides a product-based explanation of the intended role of a reacher in reducing physical movement during retrieval**
V09-02	0:35–0:58	Reacher form and gripping end demonstrated	General object retrieval following surgery or where movement is limited	User operates the handle while the gripping end remains at a distance	Remote object engagement	Reduces the need for the user's body to move directly toward the object	**Successful use still depends on positioning and controlling the tool**	**Shows that the reacher transfers part of the retrieval task from body movement to remote hand-operated control**
V09-03	1:00–1:22	Different reacher orientations / configurations discussed	Accessing objects at different positions, including shelf-level retrieval	Tool orientation is adjusted according to target position	Reach extended toward objects outside normal hand reach	Reduces the need for the user's body to move directly toward the object	**Tool selection and orientation depend on the intended task**	**Shows that reacher configuration and length need to match the location and type of retrieval task rather than functioning as a single universal solution**
V09-04	1:22–1:43	Different reacher lengths discussed	Matching reach distance to user/task requirements	Same basic gripping interaction with different tool lengths	Different reach ranges	Potentially reduces the amount of physical reaching required	**Longer reach is not automatically better; appropriate length depends on the user's body and task**	**Highlights reach length as a design variable that affects usability and access rather than simply maximising extension**

PRELIMINARY OBSERVATION

Unlike V07 and V08, V09 does not directly show how a user's posture changes when retrieving an item. Instead, it explains how to use a reacher to increase accessibility and reduce movements such as bending or twisting. It also emphasizes that the length and shape of the tool must be suitable for the user and the retrieval task

CROSS-VIDEO ANALYSIS

CROSS-VIDEO MOVEMENT PATTERNS

Comparison of coded observations across user movement, low-storage interaction and portable retrieval aid use

OBSERVED PATTERN	A — USER MOVEMENT	B — LOW STORAGE	C — RETRIEVAL AID
Forward trunk flexion	●●●	●●●	○
Kneeling / body lowering	●●	●●●	○
Deep / extended reach	●●	●●●	●●●
External body support	●●	●●	○
Recovery to standing	●●●	●●	○
Visual access / searching	●	●●	—
Remote object control	—	—	●●●

Markers indicate the relative prominence of patterns within the coded observations, not statistical frequency

LEGEND

●●● Strongly observed
●● Observed
● Limited / occasional
○ Reduced / avoided through tool use
— Not relevant / not observed

OVERALL OBSERVATION

Low-level retrieval was observed as a sequence of body positioning, reaching, object interaction and recovery rather than a single reaching action

KEY FINDINGS FROM VIDEO OBSERVATION

01 MULTIPLE MOVEMENT STRATEGIES

Low-level access was not associated with one fixed posture. Users were observed bending from standing, kneeling, and combining body lowering with reaching depending on the task

02 EXTERNAL SUPPORT

External support appeared across several observations, including the floor, chair, countertop and appliance handle, particularly during deeper lowering or reaching movements

03 ACCESS GOES BEYOND REACHING

Low-level access involved more than reaching the object. Visual searching, deep reaching and returning from a lowered position added further movement to the task

04 RETRIEVAL AIDS SHIFT THE DEMAND

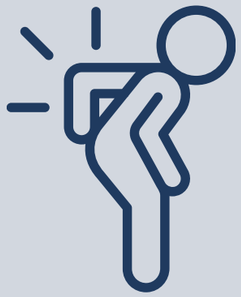
Portable reachers reduced the need for body lowering during floor-level retrieval, but introduced remote positioning, engagement and object-control tasks at the tool tip

SYNTHESIS

The observations suggest that low-storage access is not only a reach problem. Body lowering, support, visual access, object handling and recovery all contribute to the task

DESIGN IMPLICATION

01 REDUCE DEEP BODY LOWERING



OBSERVATION

Low-level tasks involved deep trunk bending, kneeling or a combination of both

DESIGN IMPLICATION

The design should reduce the amount of deep bending or kneeling required to access low storage where possible

KEY: Reduce physical lowering

02 CONSIDER RECOVERY, NOT ONLY ACCESS



OBSERVATION

Some users returned to standing gradually or used external support during lowering and recovery

DESIGN IMPLICATION

Support may be needed not only when accessing a low position, but also when returning to standing

KEY: Support lowering + recovery

03 MAINTAIN VISUAL ACCESS



OBSERVATION

In V06, trunk flexion increased while the user looked and reached further into a low drawer

DESIGN IMPLICATION

Reducing reach distance alone may not be enough if users still need to lower their body to see inside deep storage

KEY: Improve visibility + access

04 SUPPORT DIFFERENT MOVEMENT STRATEGIES



OBSERVATION

Users accessed low areas through different combinations of standing, bending, kneeling and external support

DESIGN IMPLICATION

The design should not depend on one fixed posture and should accommodate different ways of approaching low storage

KEY: Flexible interaction

05 CONSIDER OBJECT CONTROL



OBSERVATION

Portable reachers reduced body lowering, but required the user to position and control objects remotely through the tool

DESIGN IMPLICATION

Any reach-extension approach should consider how easily different household objects can be engaged, controlled and retrieved

KEY: Flexible interaction

EMERGING DESIGN DIRECTIONS

A — AVOID THE MOVEMENT

Bring the object to the user

Standing / seated → Extend reach → Retrieve remotely

Reduces the need for bending or kneeling

OR

B - SUPPORT THE MOVEMENT

Assist the user during low-level access

Lower → Access directly → Supported recovery

Allows direct interaction while potentially reducing the difficulty of lowering and rising

MARKET RESEARCH: MOVEMENT SUPPORT

WEEK 06

1 KNEELING SUPPORT



Principle:

Lower → Kneel on raised/padded surface → Use handles to rise

Supports:

- Knee contact
- Lowering
- Rising through upper-body support

Reduces floor-level kneeling depth and provides fixed hand support for recovery

2 SIT-TO-STAND ASSIST



Principle:

Sit → Compressed mechanism → Upward assistance → Stand

Supports:

- Transition from sitting
- Rising
- Reduced lower-body effort

Uses stored or powered force to assist the transition from a lower seated position

3 SUPPORT RAIL / FRAME



Principle:

Grip → Transfer body load through arms → Lower / rise

Supports:

- Balance
- Weight transfer
- Stability during transition

Provides a stable external contact point while the user controls their own movement

4 FLOOR RECOVERY / RISING AID



Principle:

Floor → Body supported → Powered elevation → Seated / Near-standing

Supports:

- Floor-level recovery
- Vertical body transition
- Reduced effort during rising
- Whole-body support

Raises the user from floor level to a supported seated position, reducing the physical effort required for recovery

5 WEIGHT-RESPONSIVE MECHANICAL ASSIST



Principle:

Body load ↓ → controlled vertical movement ↕ → supported working height

Supports:

- Working height
- Vertical transition
- Postural positioning

Uses body weight during lowering and stored mechanical force to assist the user during rising

6 POWERED FLOOR LIFTING SUPPORT



Principle:

Low position → powered lift → raised position

Supports:

- High physical assistance
- Recovery
- Users with substantial mobility limitations

Provides high lifting assistance but introduces greater size, complexity and dependence on powered mechanisms

DIRECT PRODUCT BENCHMARKETING

01 KNEELING SUPPORT

A — AIDAPT FOLDING GARDEN KNEELER

- Mechanism: Fixed padded platform + rigid side handles
- Frame: Powder-coated welded steel
- Padding: 22 mm foam
- Weight capacity: 110 kg
- Function: Can be inverted between kneeler and raised seat
- Support: Side frames act as handles during lowering and rising
- Limitation: No mechanical assistance; user still provides the force required to lower and rise

B — SAXON GARDEN KNEELING PAD WITH FRAME

- Mechanism: Fixed EVA knee pad + bilateral support handles
- Frame: Steel
- Grip: Molded hand grips
- Purpose: Reduces direct knee contact with the ground
- Support: Handles provide leverage when returning to standing
- Design emphasis: Very simple, low-cost passive support
- Limitation: Fixed platform height; no assistance through the vertical movement

C — CYCLONE FOLDABLE SEAT / KNEELER

- Mechanism: Reversible fixed platform + steel frame
- Padding: Extra-thick EVA foam
- Frame: Carbon steel
- Function: Kneeler ↔ seat
- Storage: Foldable + integrated tool holster
- Design emphasis: Portability and dual-purpose use
- Limitation: Provides cushioning/support but no active lowering or rising assistance

02 SIT-TO-STAND ASSIST

A — SITNSTAND LIFT ASSIST CLASSIC

- Mechanism: Battery-powered inflatable lifting cushion
- Operation: Button controlled
- Lift: Up to approximately 8 in / 203 mm
- Weight capacity: 400 lb / ~181 kg
- Function: Placed on an existing chair; cushion raises the seated user toward standing
- Feature: Portable and requires no permanent furniture modification
- Purpose: Reduces physical effort required during sit-to-stand transition

03 SUPPORT RAIL / FRAME

A — STANDER CHAIR CANE

- Mechanism: Fixed support handle → upper-body weight transfer
- Handle height: 32.5–42 in / ~826–1067 mm
- Weight capacity: 250 lb / ~113 kg
- Weight: 19.5 lb / ~8.8 kg
- Base: Positioned underneath furniture legs for stability
- Purpose: Provides balance and leverage during sitting/standing
- Limitation: Requires compatible furniture and provides no lifting force

B - STANDER HANDYBAR

- Mechanism: Portable handle inserted into vehicle door latch
- Weight: 1 lb / ~0.45 kg
- Weight capacity: 350 lb / ~159 kg
- Material: Steel + non-slip grip
- Purpose: Provides leverage and balance during vehicle sit-to-stand transfer
- Feature: No permanent installation
- Limitation: Highly context-specific, requires compatible vehicle latch

DIRECT PRODUCT BENCHMARKING

04 FLOOR RECOVERY / RISING AID

A — RAIZER II

- Mechanism: Battery-powered articulated lifting chair
- Capacity: 150kg
- Lift time: Approximately 20–30 seconds
- Weight: 13kg total
- Operation: Remote/control-panel activated
- Function: Components are assembled beneath the fallen user before lifting
- Movement: Floor → supported body elevation → sitting/almost-standing
- Feature: Supports the body throughout the lifting process
- Limitation: Requires assembly and is intended primarily for fall recovery rather than everyday low-level tasks

B — MANGAR CAMEL LIFTING CUSHION

- Mechanism: Battery-powered compressor → sequential inflatable support
- Maximum user weight: 320 kg
- Maximum seat height: 560 mm
- Weight: 6.5kg
- Backrest: Integrated
- Operation: Hand control
- Function: Deflates flat beside/beneath a fallen user and inflates to a supported seated height
- Feature: Can be used independently or with assistance

Limitation: Requires compressor and inflation process

05 WEIGHT-RESPONSIVE MECHANICAL ASSIST

A — CAREX UPLIFT PREMIUM SEAT ASSIST

- Mechanism: Weight-responsive non-powered lifting mechanism
- Assistance: Up to approximately 70% lift assistance
- Weight capacity: Up to 350 lb / ~159 kg for Premium model
- User input: User initiates sitting/rising while mechanism provides partial assistance
- Power: None
- Purpose: Reduces the effort required to rise without completely lifting the user
- Key relevance: Demonstrates partial mechanical assistance rather than full powered lifting

*Adjacent mechanism

06 POWERED FLOOR LIFTING SUPPORT

A — VOCIC MAIDESITE AX05

- Mechanism: Battery-powered rigid lifting chair
- Capacity: 440 lb / ~200 kg
- Operation: One-touch handheld controller
- Structure: Rigid seat + mobile dual handrails
- Function: Raises the user from floor level toward wheelchair/transfer height
- Feature: Foldable structure + seat belt
- Design emphasis: Stable rigid mechanical lifting rather than inflatable support

DIRECT BENCHMARKING MOVEMENT SUPPORT

Product	Category	Supported Movement	Mechanism	User Input	Assistance Level	Capacity	Stability	Portability	Power
Aidapt Folding Garden Kneeler	Kneeling Support	Lowering / Kneeling / Rising	Fixed padded platform + rigid side handles	User performs lowering; pushes handles to rise	Low	110 kg	High	High	-
Saxon Garden Kneeling Pad with Frame	Kneeling Support	Lowering / Kneeling / Rising	Fixed EVA pad + bilateral handles	User performs full movement using arms + legs	Low	—	High	High	-
Cyclone Foldable Seat / Kneeler	Kneeling Support	Lowering / Kneeling / Rising	Reversible fixed platform + steel frame	User performs full lowering/rising	Low	—	High	High	-
SitnStand Lift Assist Classic	Sit-to-Stand	Sitting / Rising	Battery-powered inflatable cushion	User positions body; powered lift raises seated height	High	~181 kg	Medium	High	Battery
Stander Chair Cane	Support Rail / Frame	Sitting / Rising / Balance	Fixed support handle	User transfers load through arm	Low	~113 kg	High†	Low–Med	-
Stander HandyBar	Support Rail / Frame	Vehicle Sitting / Rising	Portable handle inserted into door latch	User pushes/pulls through arm	Low	~159 kg	High†	Very High	-
Raizer II	Floor Recovery	Floor → Seated	Powered articulated lifting chair	Very low physical input during lift	Very High	150 kg	Very High	Low–Med	Battery
Mangar Camel	Floor Recovery	Floor → Seated	Sequential inflatable chambers	User remains supported during powered elevation	Very High	320 kg	High	Medium	Battery + compressor
Carex UPLIFT Seat Assist	Weight-Responsive Assist	Controlled Sitting / Rising	Body-weight compression + stored mechanical force	User provides partial movement	Med–High	Weight-adjustable	Medium–High	High	-
VOCIC MAIDeSITe AX05	Powered Floor Lift	Floor → Raised Position	Battery-powered rigid lifting chair	Minimal physical input	Very High	~200 kg	Very High	Low–Med	Battery

DIRECT BENCHMARKING COMPARISON

NORMALIZATION EVALUATION

Product	Movement Assistance	Everyday Usability
Aidapt Kneeler	2	4.5
SitnStand	4	4
Chair Cane	2	3.5
Raizer II	5	2
Mangar Camel	5	2.5
UPLIFT	4	4.5
VOCIC AX05	5	1

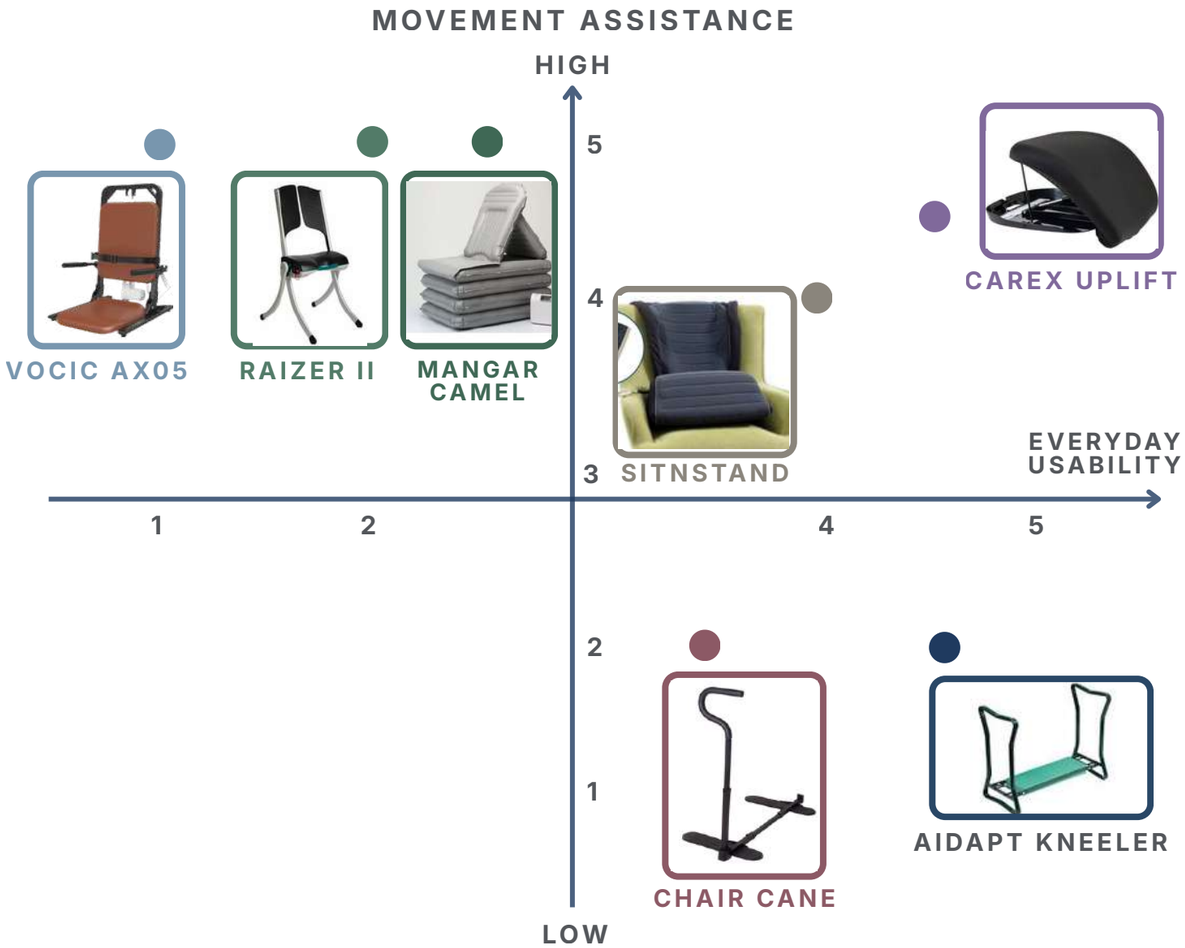
Qualitative Design Assessment

Y — MOVEMENT ASSISTANCE

- Lowering assistance
- Rising assistance
- Body-weight support
- Reduction of user-generated effort

X — EVERYDAY USABILITY

- Portability
- Setup complexity
- Power dependence
- Independent use
- Suitability for repeated household use



Key Finding

Existing products demonstrate a trade-off between simple passive support and high levels of mechanical assistance. Weight-responsive seat-assist products show that partial movement assistance can be achieved in a relatively compact, non-powered format

BENCHMARKING FINDINGS & MARKET GAP

01 USER EFFORT REMAINS HIGH

Kneeling supports and support rails are simple, portable and suitable for everyday use, but the user still performs most of the lowering and rising movement

Finding:
High usability ≠ high movement assistance

02 HIGH ASSISTANCE OFTEN REQUIRES COMPLEX SYSTEMS

Floor recovery and powered lifting products provide substantial physical assistance, but usually introduce greater size, setup requirements and power dependence

Finding:
More assistance → more complexity

03 PARTIAL MECHANICAL ASSISTANCE OFFERS A MIDDLE GROUND

Weight-responsive and sit-to-stand products show that meaningful movement assistance can be provided without fully replacing the user's own movement

Finding:
Assist movement rather than fully lift

04 EXISTING PRODUCTS ARE NOT DESIGNED FOR LOW-STORAGE ACCESS

Most reviewed products support sitting, standing or floor recovery, rather than repeated access to low household storage

In other words, the mechanism is relevant, but the context is different

Finding:
Relevant mechanism, different use context

BENCHMARKING FINDINGS & MARKET GAP

MARKET GAP
EXISTING MARKET

PASSIVE SUPPORT	PARTIAL MECHANICAL ASSIST	POWERED RECOVERY
Handles/kneeling pads/rails → simple + portable → limited assistance	Seat-assist mechanisms → compact + assisted transition → mainly designed for sitting/standing	Floor lifts/recovery chairs → high assistance → large / powered / specialized

DESIGN OPPORTUNITY

This suggests an opportunity to explore a compact support product that assists the user's vertical movement without fully lifting the body or requiring a powered floor-lift system

GAP FINDING

There appears to be limited support for everyday low-level tasks that combines the simplicity of passive kneeling aids with partial mechanical assistance for lowering and rising

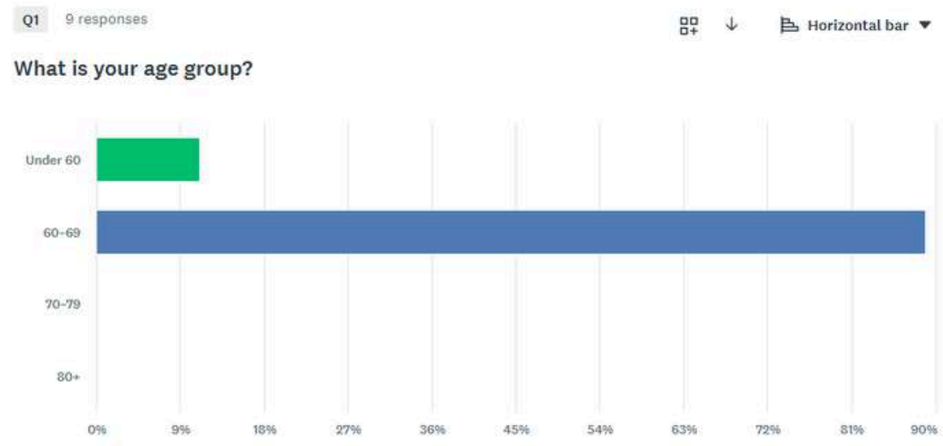
PREPARATION FOR SURVEY

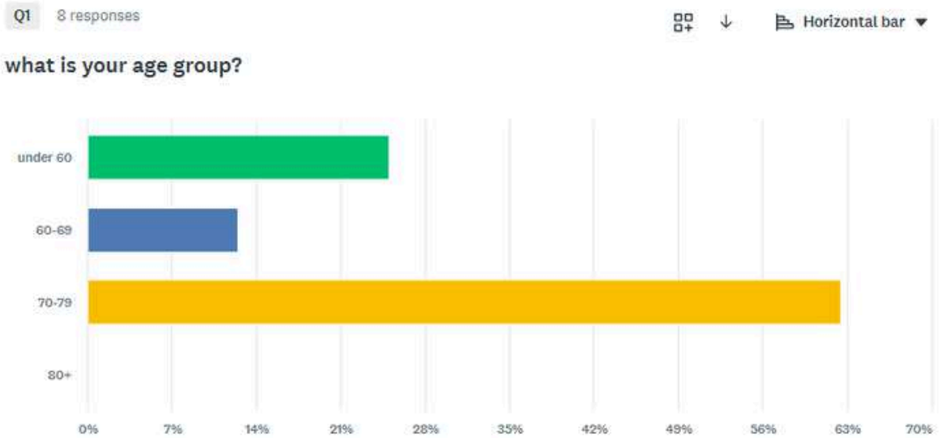
	Questions	Role
	About This Research	
Q1	What is your age group?	Participant profile
Q2	What best describes your current living situation?	Independence/context
Q3	Do you currently experience any physical difficulty that affects bending, kneeling, reaching or standing up?	Physical capability
Q4	Which storage position is MOST difficult for you to access?	Environment — Where?
Q5	Which object characteristics make retrieval from low storage more difficult?	Object — What makes it difficult?
Q6	Which movements do you normally use when retrieving an object from low storage?	Movement — How?
Q7	Which part of retrieving objects from low storage do you find MOST difficult?	Task — At what stage?
Q8	What do you currently do when an object is difficult to reach in low storage?	Behaviour — Current workaround

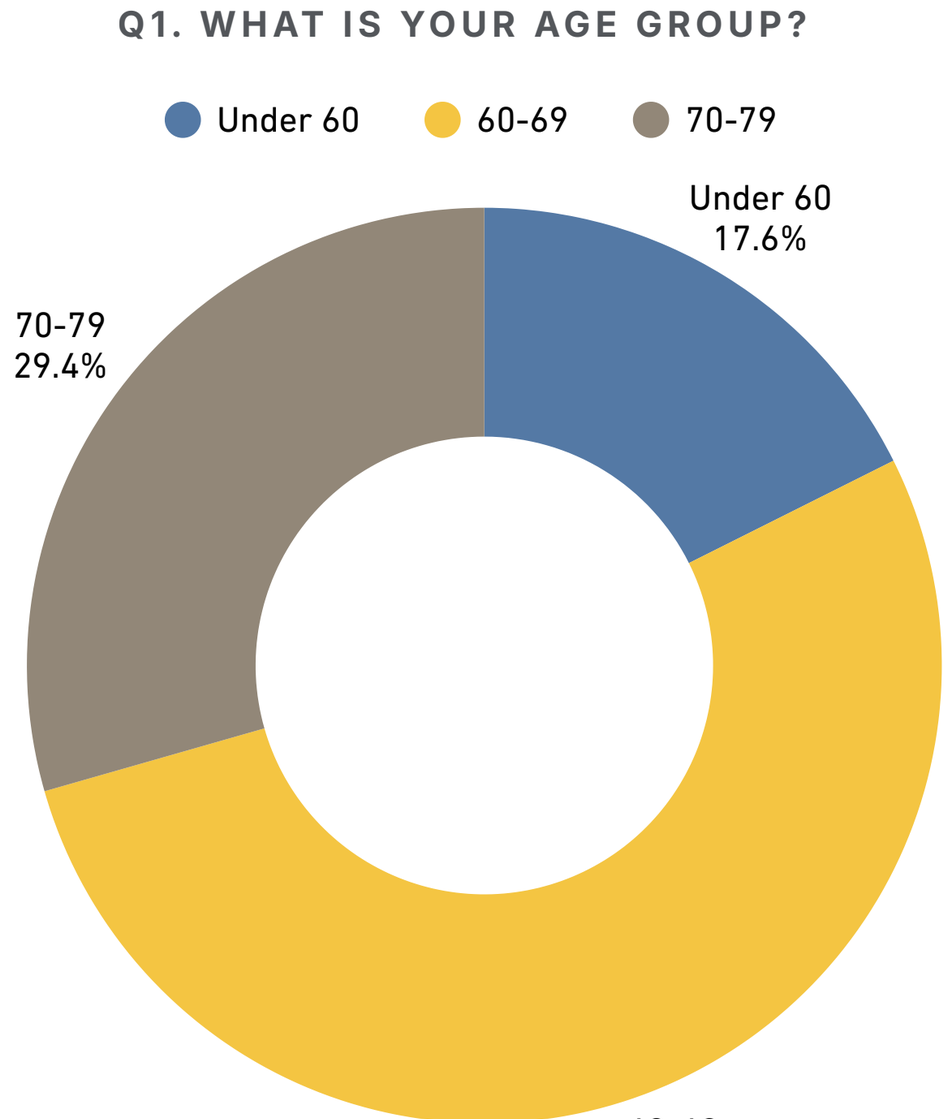
SURVEY RESULTS

RESULT SUMMARY

Survey distributed across two accounts; responses were combined into a single dataset for analysis





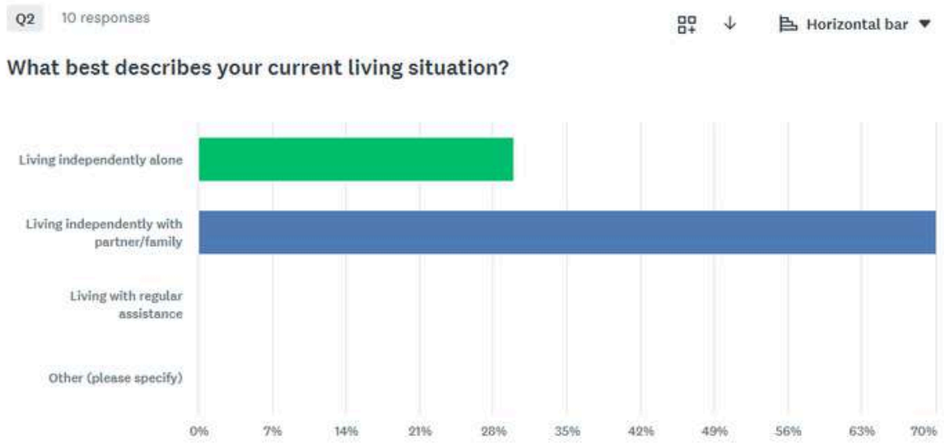


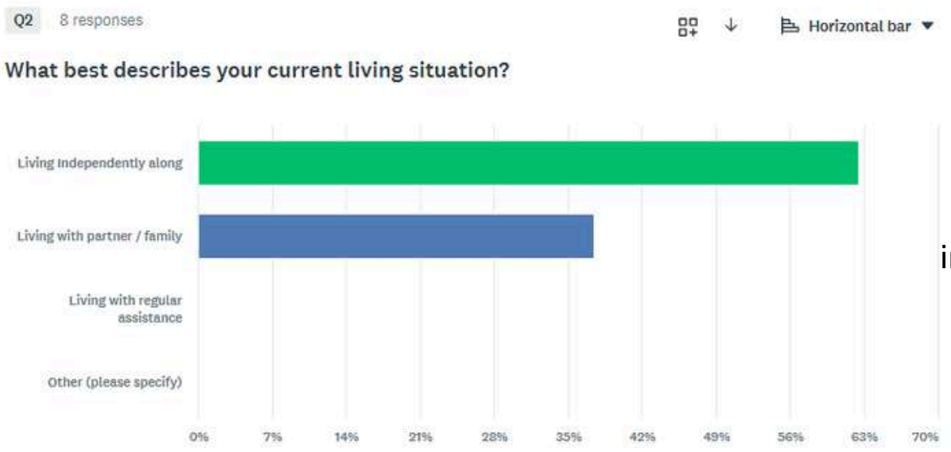
Combined responses (n = 17)

Key Finding

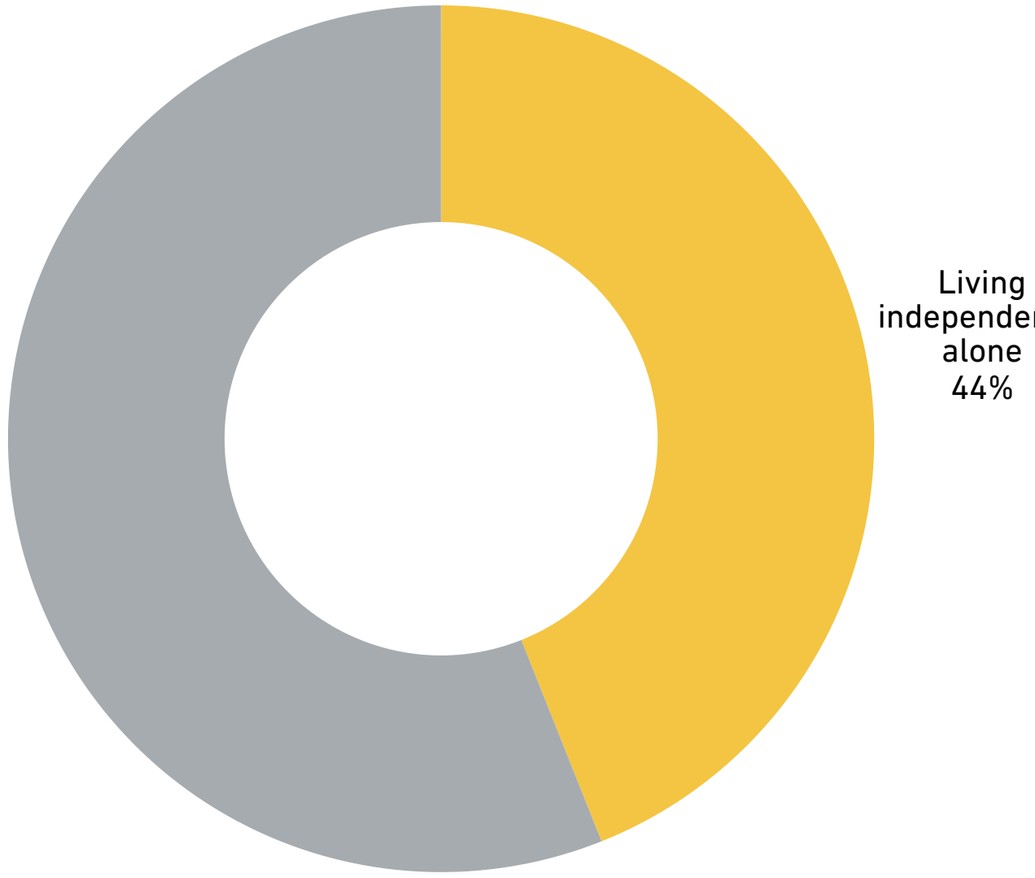
Most respondents were aged 60–69 (52.9%), followed by 70–79 (29.4%).
Participants aged 60 or older represented 82.4% of responses to this question

SURVEY RESULTS





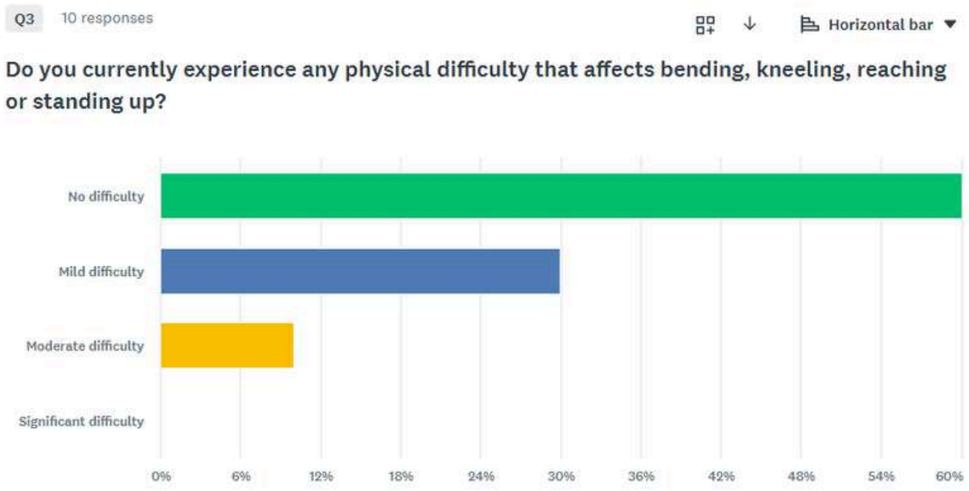
Q2. WHAT BEST DESCRIBES YOUR CURRENT LIVING SITUATION?

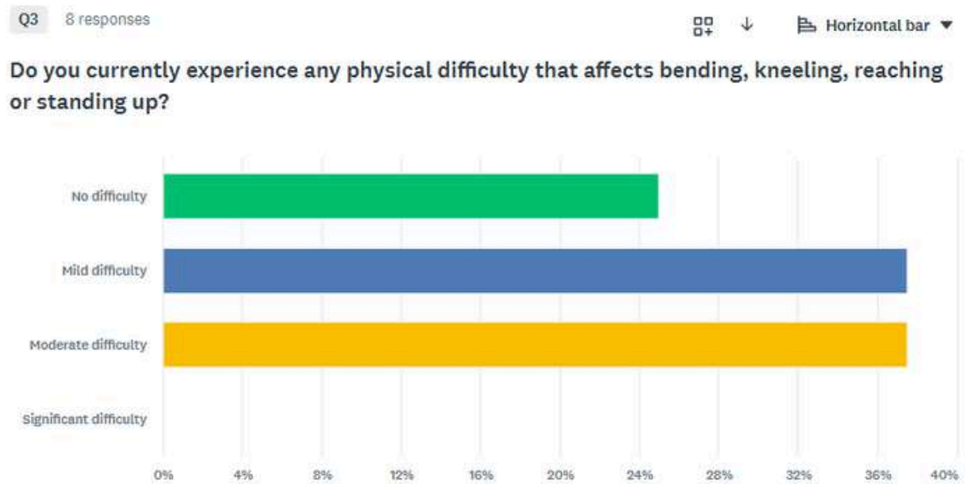


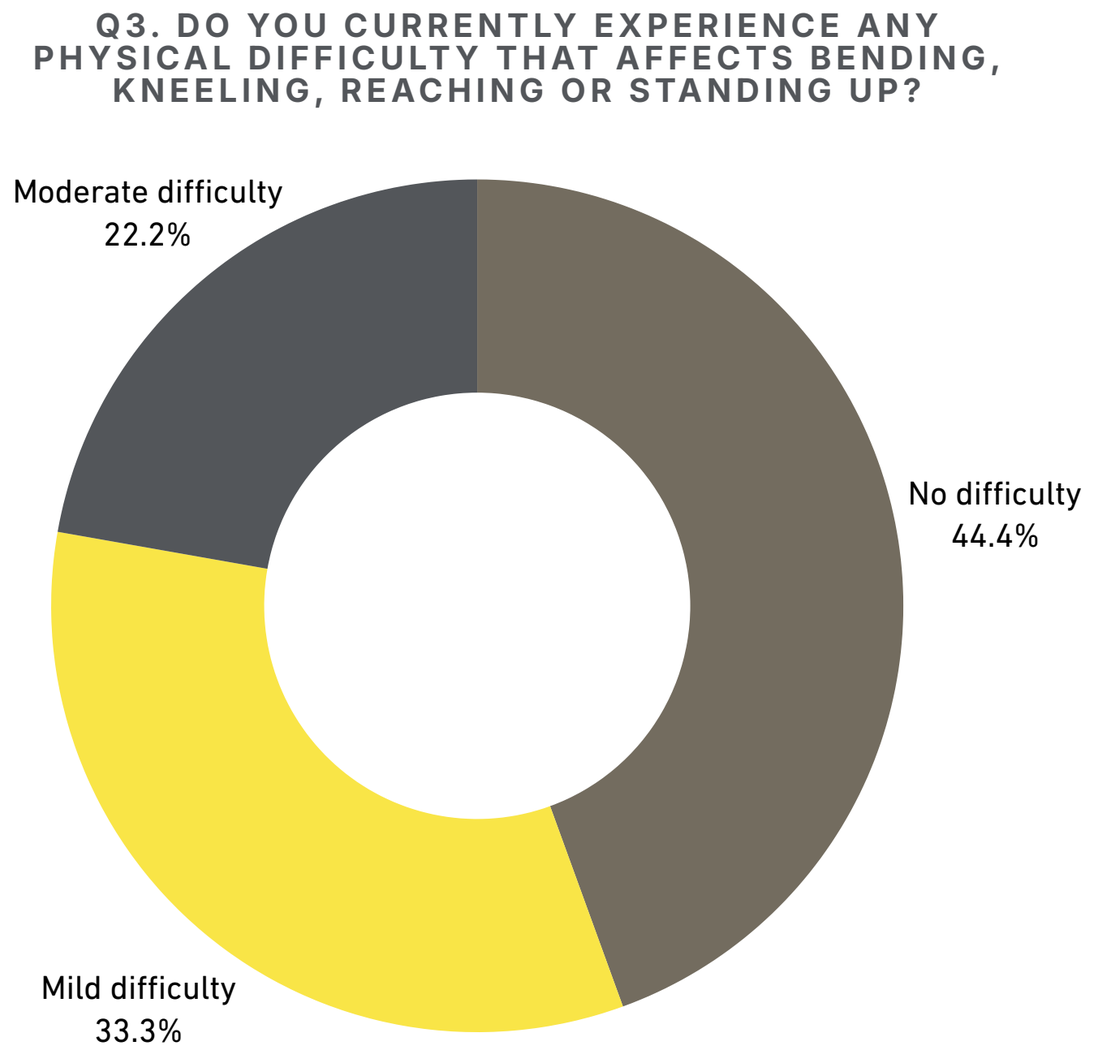
Key Finding

All respondents reported living independently, either alone (44.4%) or with a partner or family (55.6%). None reported receiving regular assistance

SURVEY RESULTS



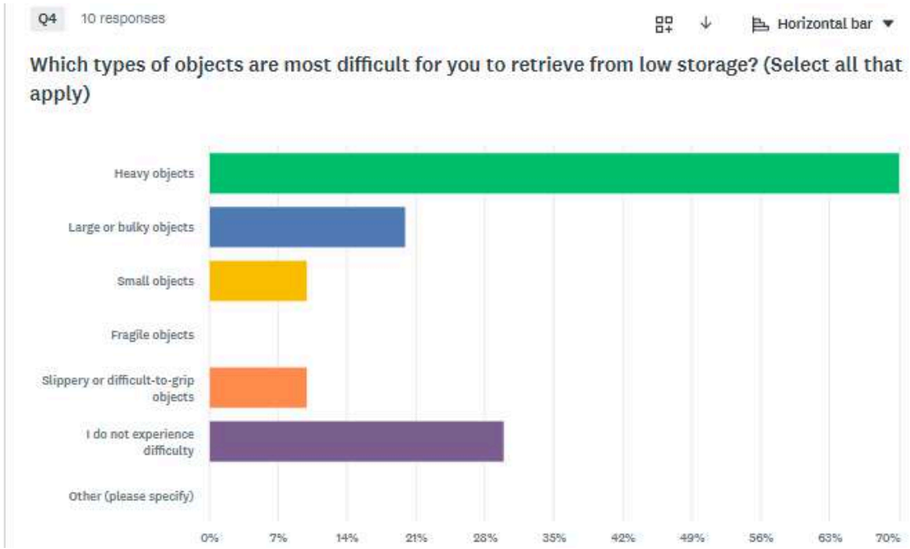


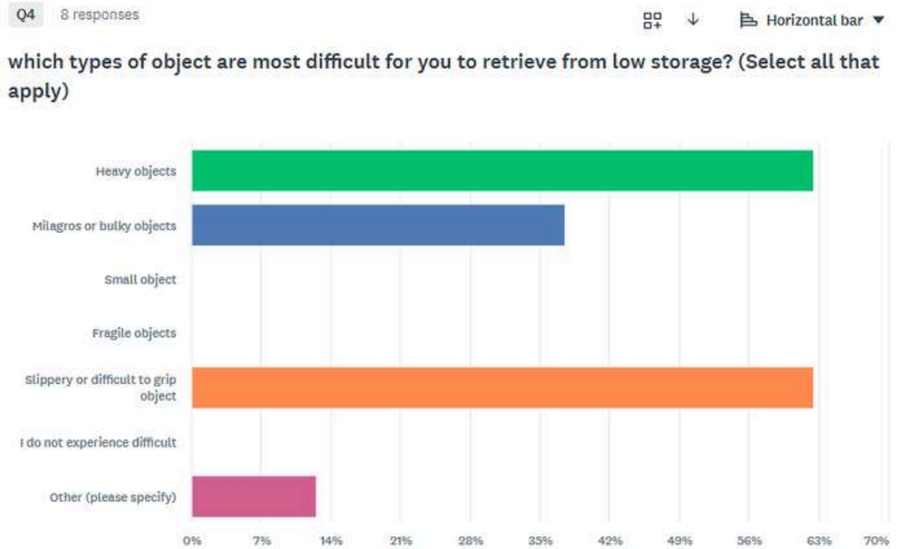


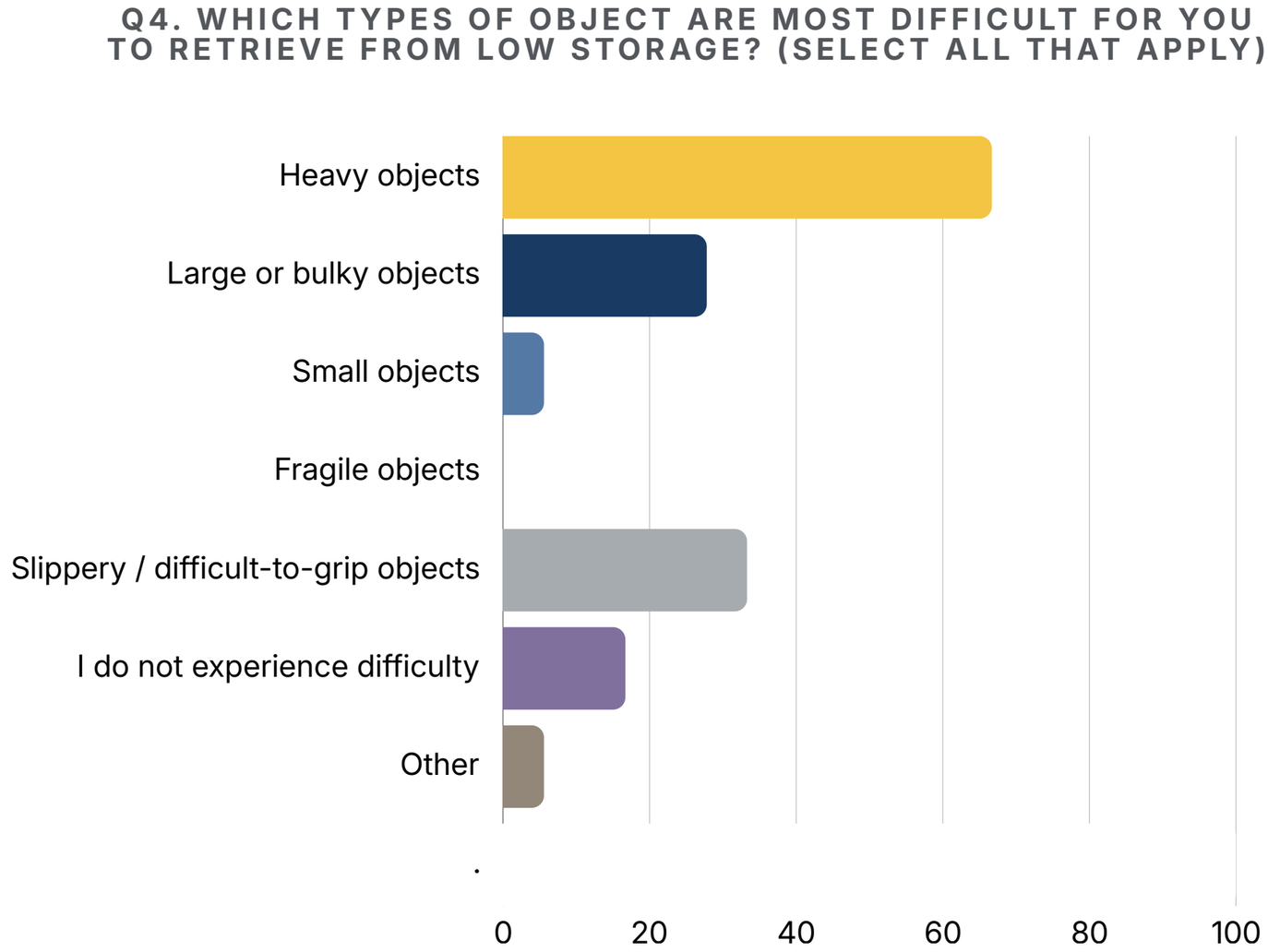
Key Finding

More than half of respondents (55.6%) reported at least some physical difficulty affecting bending, kneeling, reaching or standing up, although none reported significant difficulty

SURVEY RESULTS



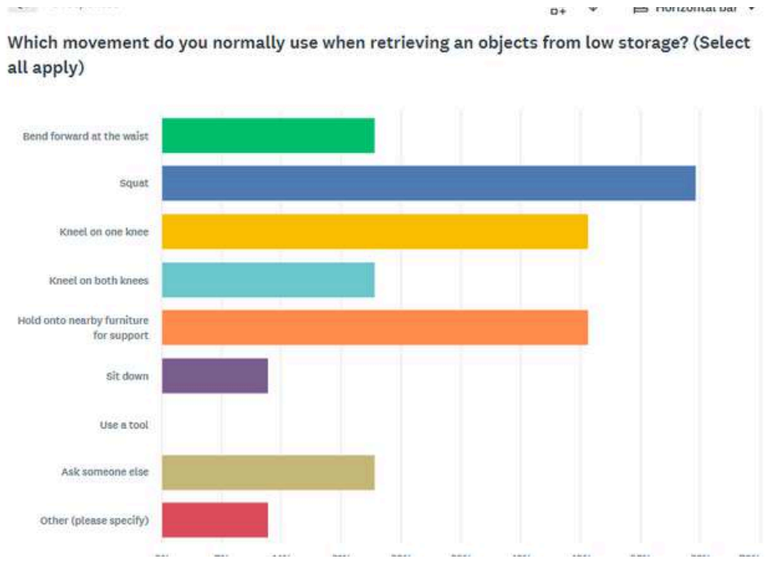


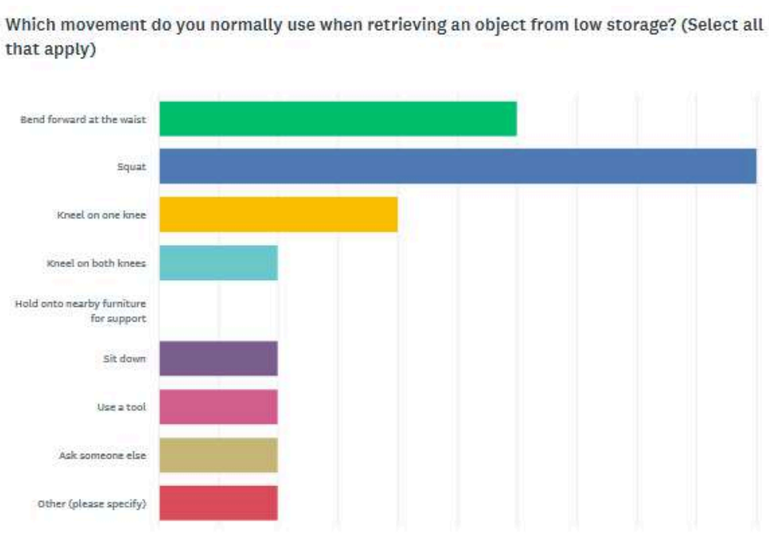


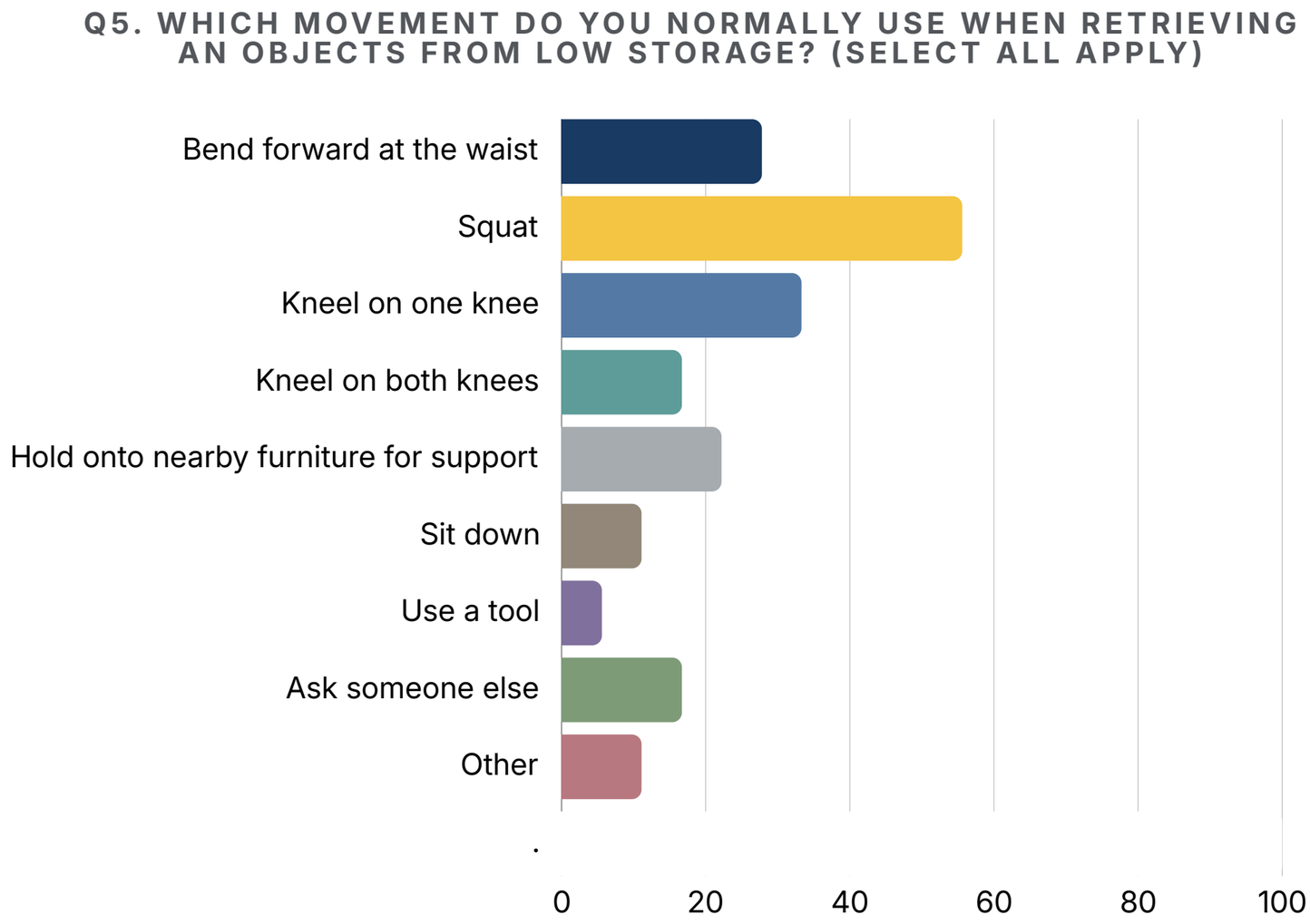
Key Finding

Heavy objects were the most commonly reported difficulty (66.7%), followed by slippery or difficult-to-grip objects (33.3%) and large or bulky objects (27.8%)

SURVEY RESULTS



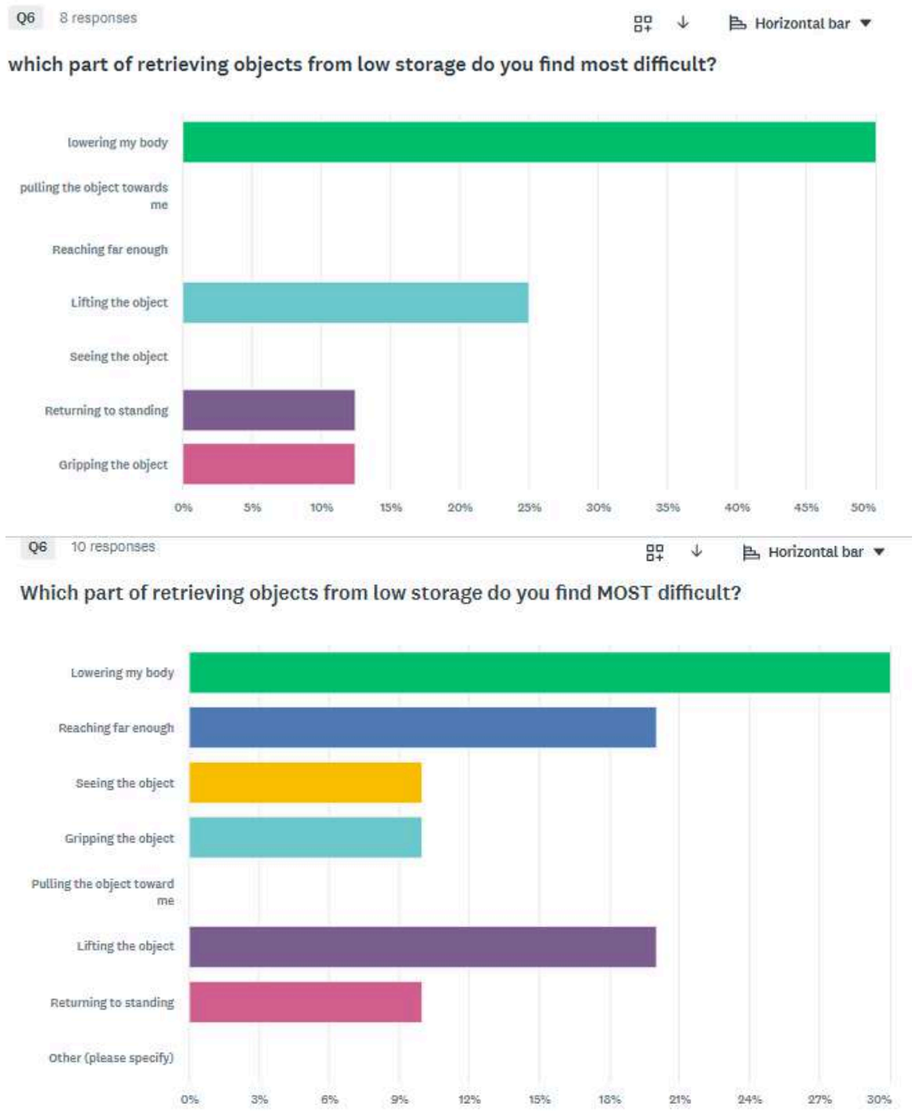




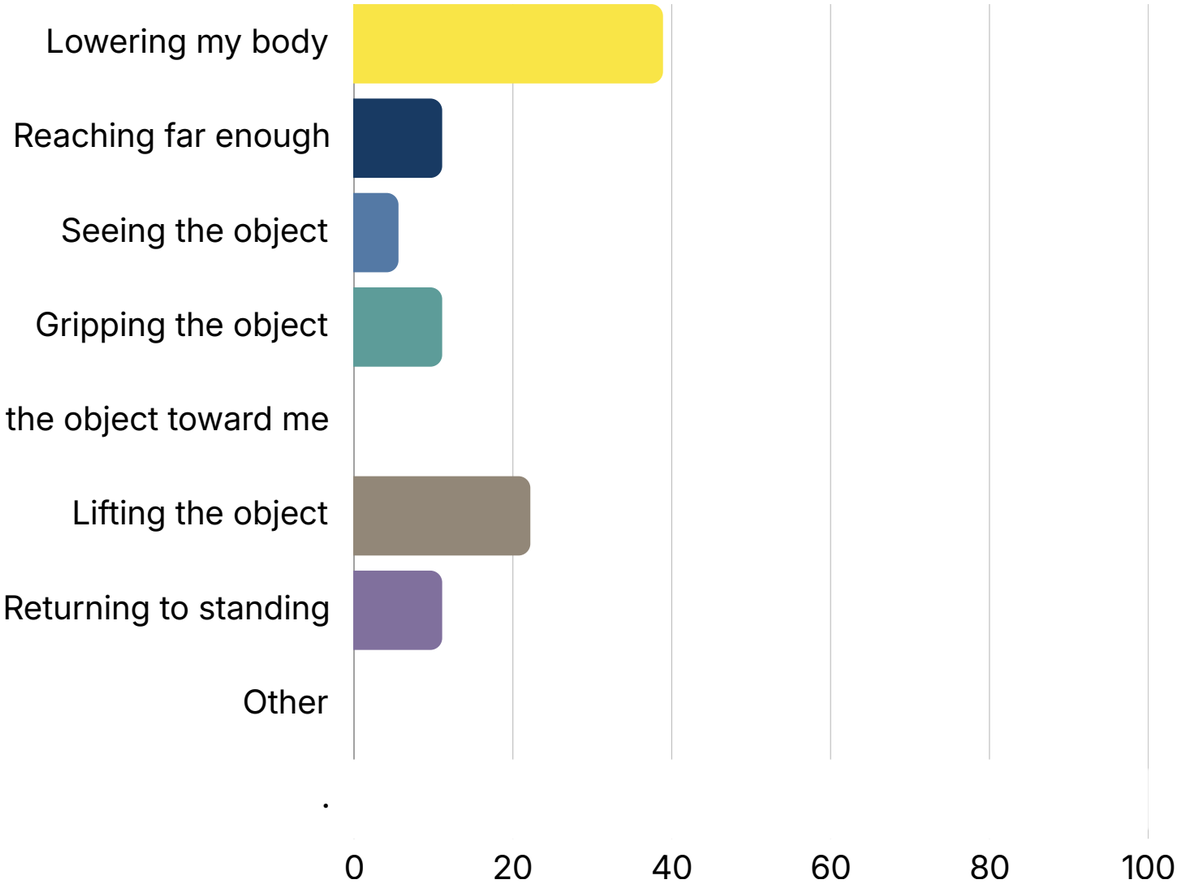
Key Finding

Squatting was the most commonly reported movement (55.6%), followed by kneeling on one knee (33.3%) and bending forward at the waist (27.8%). Notably, 22.2% of respondents reported holding nearby furniture for support, while only 5.6% reported using a tool

SURVEY RESULTS



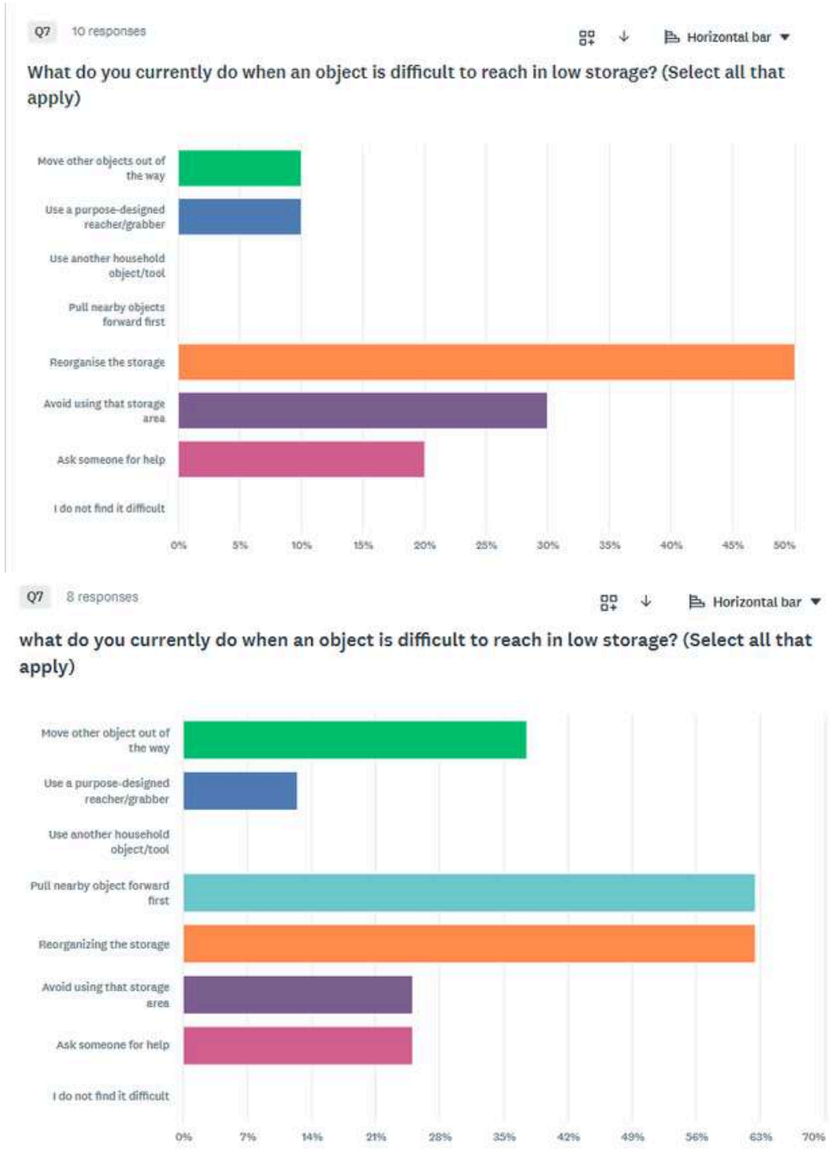
Q6. WHICH PART OF RETRIEVING OBJECTS FROM LOW STORAGE DO YOU FIND MOST DIFFICULT?

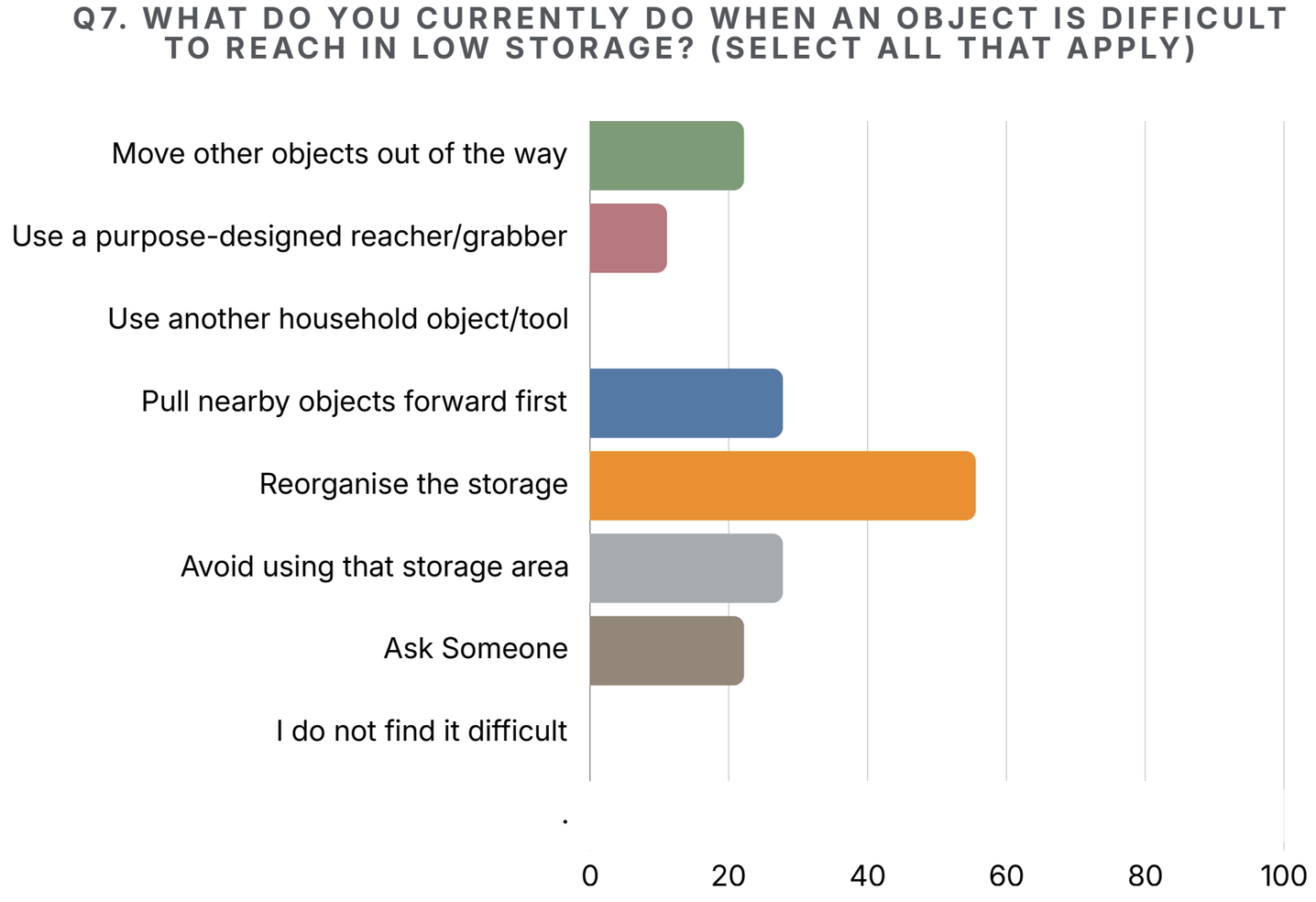


Key Finding

Lowering the body was the most commonly identified difficulty (38.9%), followed by lifting the object (22.2%). Only 11.1% identified reaching far enough as the most difficult part of low-storage retrieval

SURVEY RESULTS

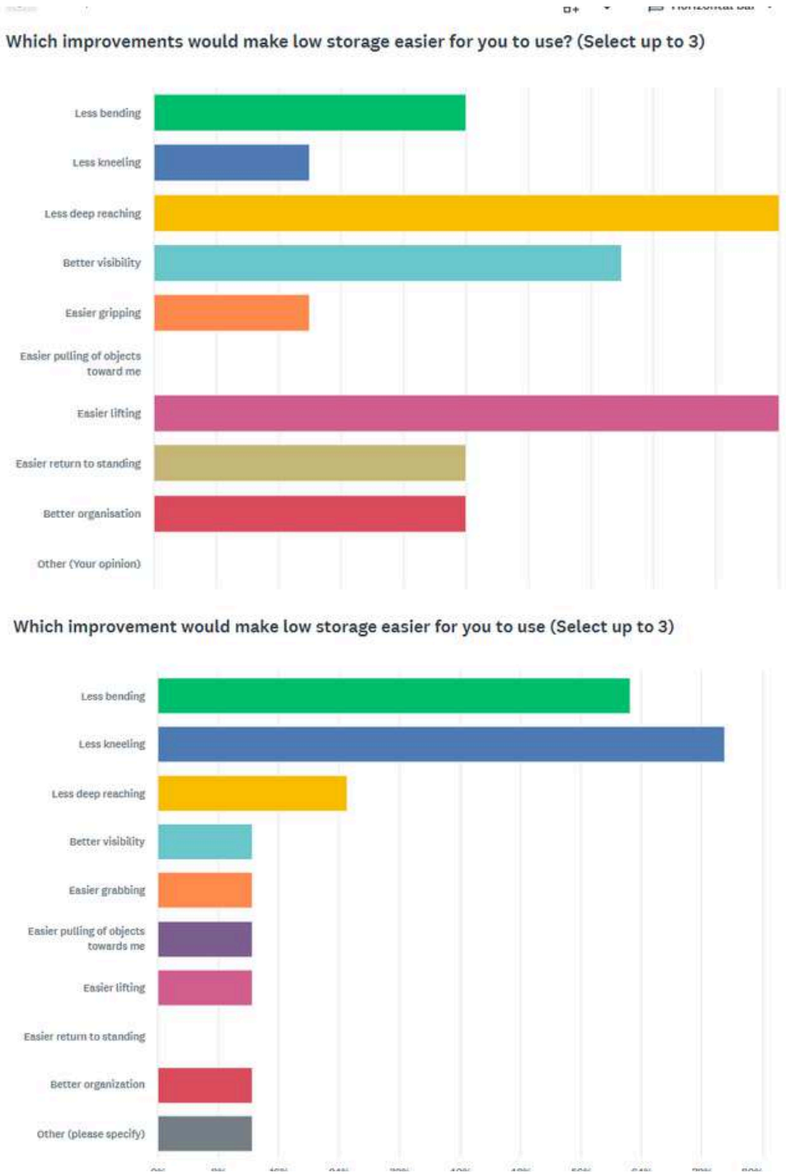


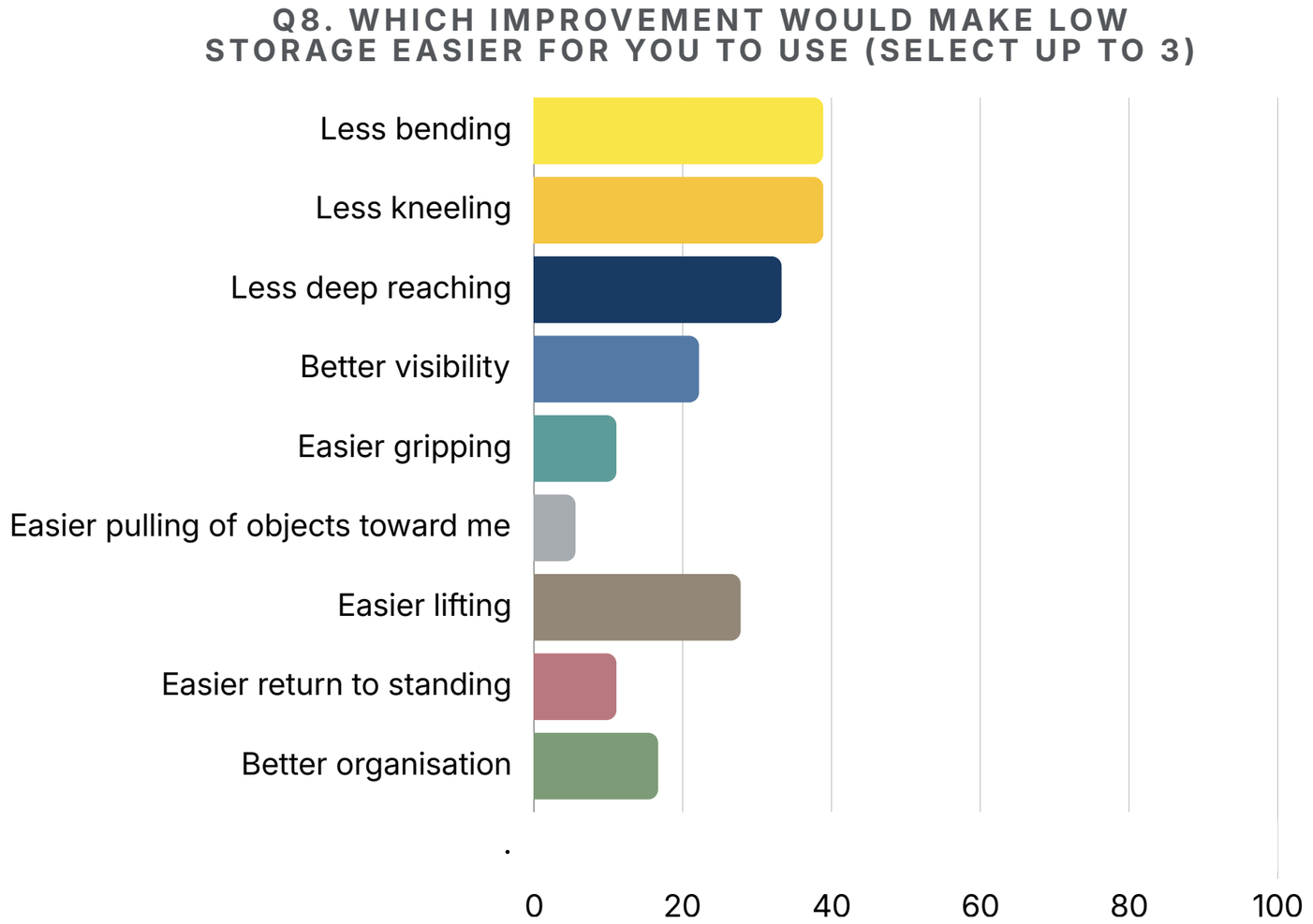


Key Finding

Reorganizing storage was the most common response (55.6%). Pulling nearby objects forward and avoiding the storage area were each reported by 27.8%, while only 11.1% used a purpose-designed reacher or grabber

SURVEY RESULTS





Key Finding

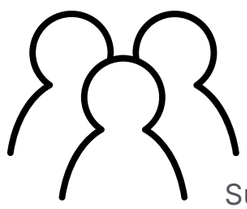
Reducing bending and kneeling were the joint highest priorities (38.9% each), followed by reducing deep reaching (33.3%) and making lifting easier (27.8%)

OVERALL SURVEY ANALYSIS

PARTICIPANT OVERVIEW

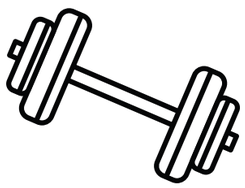
The survey received 18 responses, with most participants aged over 60

10 of 18 participants reported some level of physical difficulty



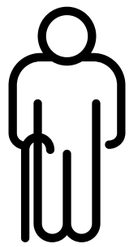
18

Survey responses



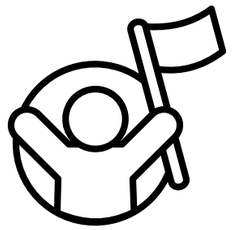
10 / 18

Reported some level of physical difficulty



82.4%

Over 60+



8 / 18

Lived alone

10 lived with a partner or family

OVERALL SURVEY FINDINGS

Lowering was the most frequently selected difficult stage

Most reported difficulties occurred while accessing the storage, especially during lowering

Lowering was the most difficult single stage.

7 of 18 participants (38.9%) selected lowering, much higher than reaching, gripping, lifting or rising

The problem involves the whole body, not just reach.

The results suggested that improving low storage access should consider how users lower and support their body, as well as how they interact with objects