Enhancing the Wellbeing of People Living with POTS

Accessible Exercise Rehabilitation

Nicole Mangila

Authenticity Statement

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

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STATEMEN

Executive Summary

This report explores how people living with Postural Orthostatic Tachycardia Syndrome (POTS) experience exercise rehabilitation, one of the most effective strategies for improving functional capacity and long-term symptom stability. Through benchmarking, literature review, interviews, surveys, and thematic analysis, the study identifies a clear gap between clinical recommendations and real-world user experience.

Findings show that five factors,adaptability, preference, confidence, progression, and accessibility, shape whether individuals can safely and consistently engage in exercise. Participants reported compromised time and energy, difficulty accessing reliable information, inconsistent medical support, low motivation when exercises felt mismatched, and significant financial and logistical barriers.

Overall, the report demonstrates that effective POTS rehabilitation requires personalised, flexible, and symptom-responsive approaches. These insights highlight opportunities for designing exercise solutions that better support long-term adherence and improve quality of life for people with POTS.

Nicole Mangila

Definitions

WORD	DEFINITION
Endrometriosis	*Endo or Endometriosis is a when tissue is found outside of the uterus, usually in the reproductive organs in the pelvic area, it responds to the hormones that fluctuate during a menstrual cycle (Michigan Medicine, 2022).*
RPE	*Stands for Rating of Perceived Exertion, which measures the overall physical effort and fatigue (Cleveland Clinic, 2023).*
RPD	*Stands for Rating of Perceived Dyspnea, which measures the Shortness of breath or breathing difficulty (Crisafulli & Clini, 2010).*
ESSAM	*Stands for Exercise & Sports Science Australia Member (Andrews, 2021)*
AEP	*Stands for Accredited Exercise Physiologist (Essa, n.a)*
AES	*Stands for Accredited Exercise Scientists (Essa, n.a)*

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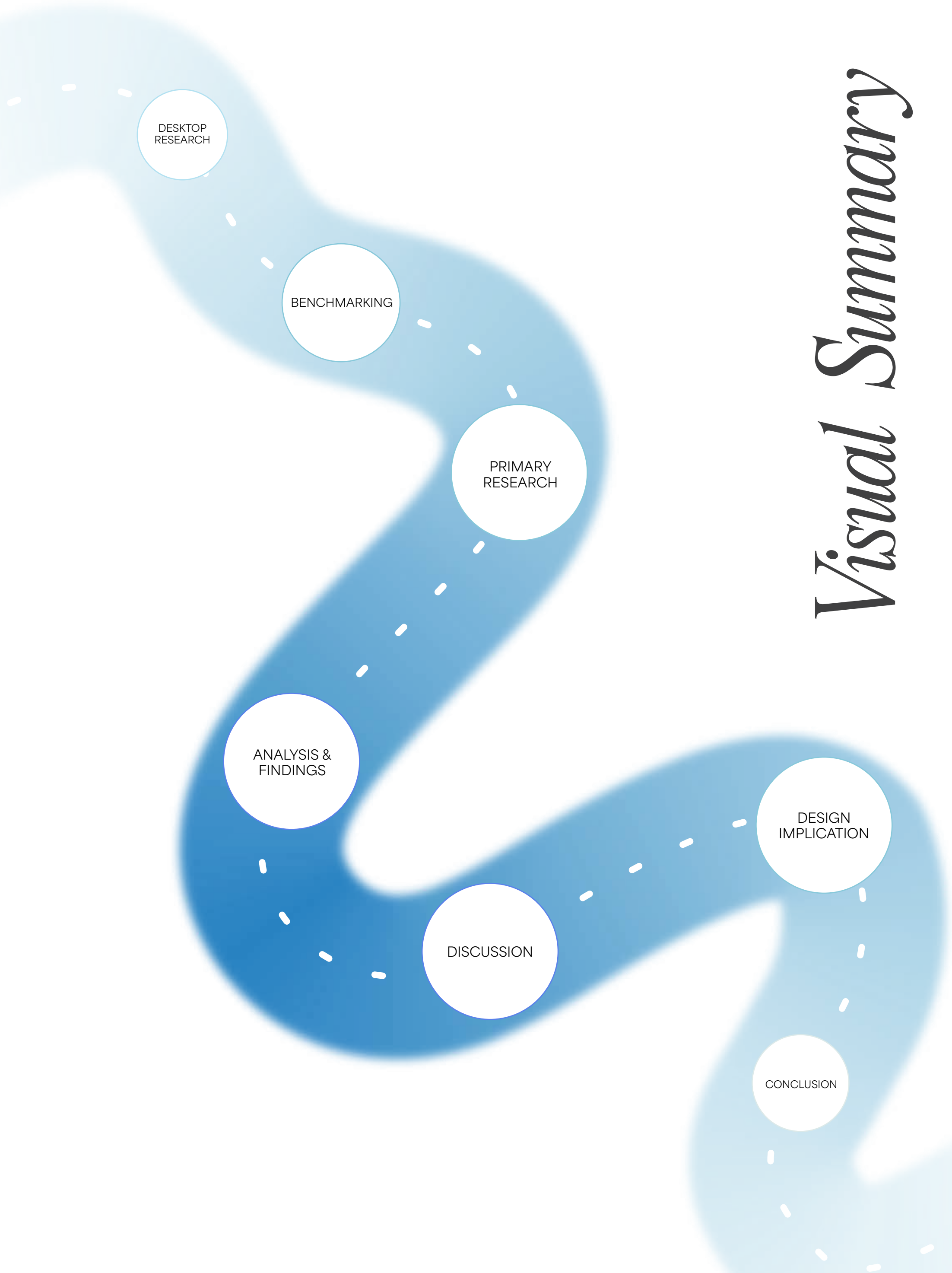
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Visual Summary



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01

THE TOPIC

1.1 Introduction

1.2 Background

1.3 Benchmarking

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1.1 Introduction

Walking is one of the most fundamental human movements, so ordinary that most of us never consciously think about it. But for people living with Postural Orthostatic Tachycardia Syndrome (POTS), walking becomes a complex, symptom-triggering task.

Sometimes referred to as dysautonomia, an umbrella term for multiple conditions that affect the autonomic nervous system (ANS), POTS specifically targets the heart rate creating a spike when the individual stands up. Palpitations, chest pain or dizziness are a few of many symptoms caused due to the changes of blood flow and the heart rate (The POTS Foundation, 2025). To manage these symptoms, there are many options such as salt intake, compression garments and medication, however, another effective and non-pharmaceutical option is through exercise rehabilitation (Huynh, et al. 2025).

Exercise Rehabilitation varies from individual to individual, some effective examples includes, endurance building exercises that supports sitting or laying positions such as biking, rowing and swimming and pilates improving ones quality of life, energy amd grip strength (Cortez, et al, 2025; Rich, et al. 2025).

The aim of this report is to understand the challenges and opportunities of exercise rehabilitation of people living with POTS.

1.2 Background

In Australia, there are currently over 800,000 cases of POTS with 90% of those being women (The POTS Foundation, 2025). With it being increasingly known especially since COVID-19, as one study shows, that from 467 Long COVID cases 39% of those were diagnosed with POTS, there is no cure and many initial triggers (Björnson et al., 2025). Many fail to get diagnosed by clinicians due to their lack of training, limited referral pathways, symptom complexity (The POTS Foundation, 2025).

> ***1 in 2 Clinicians are "not at all confident" diagnosing POTS***
>
> ***(The POTS Foundation, 2025)***

> ***6.9 years diagnostic delay in Australia***
>
> ***(The POTS Foundation, 2025)***

Misdiagnosis is common for people living with POTS, where a survey of 4835 responders, 77% of individuals reported being told that they had a psychiatric or psychological disorder before their diagnosis of POTS (Satish R Raj, et al., 2022).

1.2.1 POTS Symptoms

Research describes POTS is different for every individual, it often leads to dizziness, lightheadedness, presyncope, and difficulty concentrating. Patients frequently report "fatigue, palpitations, tremulousness, and exercise intolerance" (Raj et al., 2020), reflecting the cardiovascular and neurological strain caused by impaired autonomic compensation. More recent reviews note that individuals may also experience "gastrointestinal symptoms, sleep disturbances, and cognitive impairment" (Arnold et al., 2022), alongside headaches, temperature dysregulation, and nausea. Because symptoms can fluctuate day-to-day and worsen with heat, exertion, or prolonged standing, POTS can significantly affect mobility, daily functioning, and participation in routine activities (Raj et al., 2020).

> ***"When you meet a person with POTS it is one person with POTS"***
>
> ***Callum Schild***
>
> ***ESSAM, AES, AEP, Partner of Lofty Health and Wellness***
>
> ***(Challenges That Change Us, 2024)***

1.2.2 Non-pharmacologic Management

There are several non-pharmacological management strategies for POTS, including patient education, avoidance of symptom-exacerbating medications, management of comorbid conditions (see Section 1.2.4.1), oral rehydration and salt supplementation to increase plasma volume and orthostatic tolerance, physical activity and graded exercise training, head-up sleep positioning, and the use of compression garments to shift pooled blood from the lower extremities back into central circulation. These strategies are considered first-line management because they directly target autonomic dysfunction and improve functional capacity. As symptom profiles and comorbidities vary widely, these approaches must be individualised. Collectively, they improve quality of life and reduce the risk of symptom exacerbation in people living with POTS (Huynh et al., 2025).

1.2.3 Exercise Rehabilitation

Studies show, exercise is beneficial for people with POTS because it helps strengthen the cardiovascular system, improving blood volume, stroke volume, and overall tolerance to upright posture. Over time, these physiological changes reduced symptom severity making daily activities feel more manageable (Cortez, et al. 2025).

People living with POTS present with highly individual symptom profiles, meaning no single exercise modality is universally appropriate. However, several forms of exercise have demonstrated meaningful improvements in quality of life (Cortez et al., 2025). Evidence indicates that cardiopulmonary training such as biking, rowing, and swimming supports POTS management by expanding blood volume and increasing venous return, thereby improving autonomic stability (American Heart Association, 2024; Cortez et al., 2025). Research also highlights the value of beginning with recumbent exercises before gradually progressing to upright positions, accommodating individuals with comorbidities and fatigue (see Section 1.2.4.1). These approaches require supervision, adaptation, and individualisation to ensure safety and no drop outs (Rocco et al., 2024).

Strength training can be incorporated once a person tolerates both recumbent and upright aerobic activity, although many individuals report difficulty performing even basic movements due to severe fatigue or orthostatic symptoms (Rocco et al., 2024). More recently, pilates-based exercises have shown promise in POTS rehabilitation, with case studies reporting improvements in grip strength, gait speed, energy levels, and cognitive performance, all contributing to enhanced functional capacity and quality of life (Folmar et al., 2019; Rich et al., 2025).

1.2.4 Challenges

1.2.4.1 Comorbidities

Comorbidities are medical conditions that coexist alongside a primary diagnosis (Cleveland Clinic, 2024). Research shows that many people living with POTS have at least one comorbidity, with commonly reported conditions including migraine headaches, Irritable Bowel Syndrome, Ehlers-Danlos syndrome, Chronic Fatigue Syndrome, asthma, fibromyalgia, Raynaud's phenomenon, iron-deficiency anaemia, gastroparesis, vasovagal syncope, inappropriate sinus tachycardia, mast cell activation disorder, and various autoimmune diseases (Shaw et al., 2019). The presence of these comorbidities, combined with the wide variability in symptom presentation among individuals with POTS, makes prescribing an exercise rehabilitation routine particularly challenging.

1.2.4.2 Accessibility

Based on **The POTS Foundation's 2025 Annual Report**, which includes over 2,500 expert and patient responses, people with POTS face significant accessibility challenges. These include financial barriers, Australian treatments are not government-funded and patients lose an average of $40,000 per year, diagnostic barriers (outlined in Section 1.2), and major educational disruption, with 85% reporting academic decline and missing an average of 88 school days per year. Together, these barriers create a system where accessing appropriate, consistent, and timely POTS treatment becomes extremely difficult (The POTS Foundation, 2025).

1.2.5 Emerging Topics

Existing research shows that although exercise is widely used to manage POTS, there is very limited evidence describing how it works in real-world or long-term settings. Key uncertainties remain around optimal duration, dosing, the effects of stopping exercise, and how overtraining or undertraining influence symptoms, especially since most studies only follow patients for 3-6 months. Clinicians also observe that many individuals become more symptomatic when they stop exercising and may experience flares triggered by illness, stress, injury, or excessive exercise, highlighting the need for continued investigation into long-term outcomes and exercise tolerance in POTS (Cortez, etal. 2026).

1.2.6 Summary

In summary, exercise is effective in supporting people living with POTS, encouraging individuals to regain independence and improve their quality of life. However, significant challenges remain, including financial barriers, limited evidence on long-term exercise routines, and the need for highly individualised programs that adapt to fluctuating symptoms. These gaps highlight the absence of consistent standards for what effective POTS exercise support should look like, creating a need for benchmarking to identify, compare, and define best-practice approaches.

1.3 Benchmarking

The benchmarking section examines existing exercise rehabilitation products currently available on the market. Its purpose is to analyse each product's features, constraints, and effectiveness across medical, design, and emotional dimensions, providing a structured basis for comparison. Because exercise rehabilitation plays a crucial role for people living with POTS, these products must meet a reliable standard of performance to accommodate the diverse and fluctuating needs of users.

1.3.2 POTS Specific Criteria

Following the *Recommended Exercises for POTS Rehabilitation*, they are categorised by type of exercise (Rocco, et al. 2024):

1. Recumbent: (1) Indoor & (2) Outdoor Recumbent Bike and (3) Rowing
2. Strength Training & Core: (4) Leg Press, (5) Seat Row and (6) Back Extension
3. Flexibility & Balance exercises: (7) Reformer, (8) Gymball and (9) Yoga Mat

Categorising the equipment ensures that each product is measured only within its relevant functional context and avoids unfair cross-category comparisons, these products will be graded.

Drawing from the most frequently recommended elements for exercise routine design (identified in the survey responses in Appendix 1), four POTS relevant elements were selected for comparison:

(1) Adjustability & Individualisation,
(2) Tracking & Symptom Monitoring,
(3) Safety & Comfort &
(4) Progression Structure.

These elements allow a clinically grounded assessment of the exercise rehabilitation market to see which existing equipment supports the unique needs of this population.

1.3.3 Emotional Connection Criteria

Understanding the emotional connection a user has to an exercise is essential in rehabilitation. Building on Section 1.2.3 and the identified accessibility challenges, three key criteria were addressed: (1) drop-out rates, (2) supervision requirements, and (3) quality of life. The placement of each exercise modality was informed by existing research, including case studies on *Recommended Exercises for POTS Rehabilitation*, which highlight both adherence patterns and participants' emotional responses to exercise (e.g., "difficulty getting out of bed," "dizziness was diminished in the exercise group... but not in the control group") (Rocco et al., 2024). For Pilates-based exercises, the study *Multimodal Group Rehabilitation Improves Function in Postural Orthostatic Tachycardia Syndrome (POTS)* was examined to understand its impact on functional improvement and user experience (Rich et al., 2025).

1.3.4 Developing the General Design Criteria

Following the *Global Report on Assistive Technology*, it is understood that there are many influences on the need for assistive technologies, these include; *"a person's functional ability, level of awareness, socioeconomic situation, living context, and their interaction with the environment"* (The World Health Organisation, 2022). As a result, the key words in Figure 6 was mentioned, which in turn was used to create the 6 categories for the General Design Criteria.

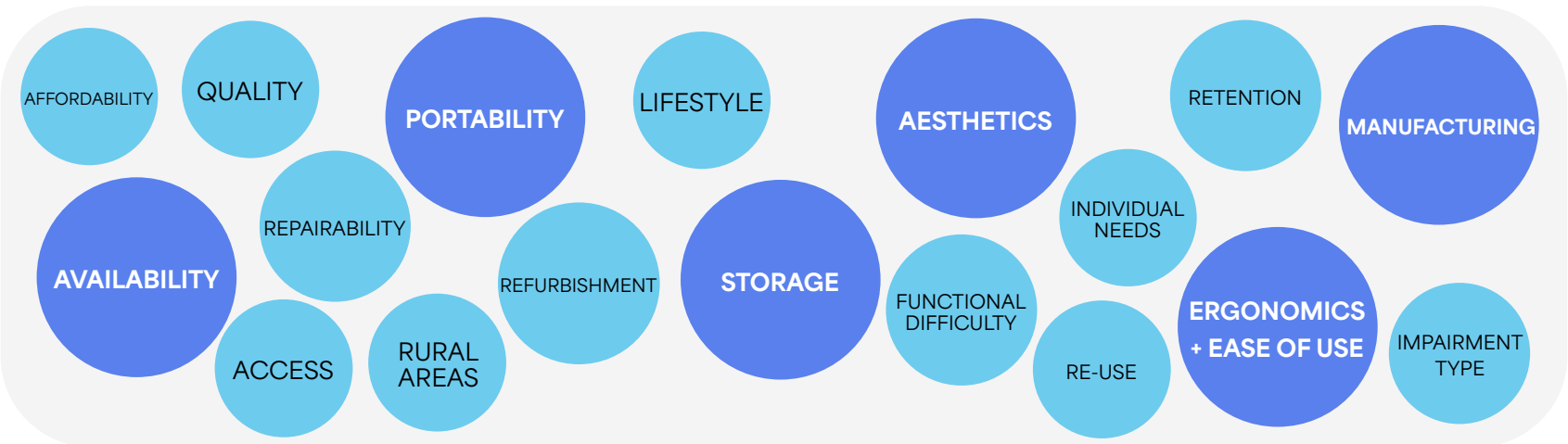


Figure 1 Word Map of Assistive Design Key Elements

To assess every exercise products in Section 1.3.2, a scoring system (Table 2) will be used to form a comparison table and a spider matrix. The grading system is based on product reviews, pricing and research from each product table matrix.

Criteria	Rank				
	1	2	3	4	5
Availability	Not on the market	Barely on the market	Limited Availability; niche suppliers	Widely available; multiple suppliers	Easily accessible; mainstream and consistently stocked
Manufacturing	Difficult to manufacture; specialised equipment required	Moderate difficulty; multiple complex steps	Standard manufacturing processes; some complexity	Ease to manufacture; minimal specialised components	Highly scalable; simple, low-cost production
Portability	Not portable; fixed in place	Heavy or bulky; difficult to move	Moderately portable; can be moved with effort	Lightweight; easy to carry	Highly portable; compact and effortless to transport
Storage	Requires large or specialised storage	Bulky; difficult to store efficiently	Moderate storage needs	Compact; easy to store	Minimal storage required; fits anywhere
Aesthetics	Unappealing; visually harsh	Basic appearance; functional but not inviting	Neutral design; acceptable but not engaging	Pleasant design; visually appealing and thoughtfully considered	Inviting, aesthetic, and supportive; communicates comfort, calmness, and user-friendliness
Ergonomics & Ease of Use	Difficult to use; poor ergonomics	Requires training; unintuitive	Moderately easy to use; some ergonomic considerations	Comfortable and intuitive; user friendly	Highly ergonomic; effortless and accessible for all users
Adjustability & Individualisation	No adjustability; fixed settings that cannot accommodate individual needs	Minimal adjustability; limited options that only suit some users	Moderate adjustability; basic customisation for common variations	High adjustability; multiple settings that support personalised use	Fully individualisable; adaptable to diverse symptoms, abilities, and progression needs
Tracking & Symptom Monitoring	No tracking features; no support for monitoring symptoms or activity	Basic manual tracking; user-dependent and inconsistent	Standard tracking; records essential metrics but lacks symptom-specific detail	Advanced tracking; integrates meaningful data relevant to POTS management	Comprehensive monitoring; provides clear, actionable insights for symptom patterns and progression
Safety & Comfort	Unsafe or uncomfortable; increases risk of symptom exacerbation	Limited safety features; discomfort likely during use	Generally safe; acceptable comfort with minor limitations	High safety; supportive and comfortable for most users	Clinically aligned safety and comfort; designed to minimise orthostatic stress and maximise user stability
Progression Structure	No progression pathway; cannot support gradual improvement	Minimal progression; few options for scaling difficulty	Moderate progression; supports basic step-wise increases	Strong progression; structured options for graded improvement	Clinically appropriate progression; enables safe, incremental advancement tailored to POTS rehabilitation

Table 2: Criteria Description of the Ranks for "General Design Criteria" & POTS Specific Criteria

1.3.5 Recumbent Exercise Equipment

The most expensive and innovative equipments that could be found of the respective recumbent exercise equipment was used as a fair comparison.

PRODUCT	1	2	3
	DYACO 4.0R PT RECUMBENT BIKE	SCORPION FS 26 RECUMBENT BIKE	BLACK CONCEPT2 ROWERG ROWER
	 *(Rehab Technology, 2026)*	 *(Everfit, n/a)*	 *(Rogue, n/a)*
DESCRIPTION	"A stationary indoor cardio machine that positions the rider in a reclined seat with a full backrest, with pedals located in front of the body rather than directly below it. Instead of sitting upright over a narrow saddle, you lean back into a wide bucket-style seat." (Vukas, 2026). **$3,999 - $212 | 80kg | 1440 x 740 x 1200 mm**	"A recumbent road bike is a human-powered bicycle designed for outdoor riding in a reclined position, with legs extended forward and the rider's back supported by a seat that angles away from vertical." (Vukas, 2026) **$8889 - $1057 | 18kg | 1440 x 740 x 1200 mm**	A Rowing Machine's order of the drive is legs first, then back, then arms. On the recovery, you reverse it: arms forward, torso hinges, then knees bend. (Vukas, 2026) **$1705 -$165 | 26kg | 356 x 610 x 2438 mm**
TARGET			

PROS	• Power: Self Generator
	• Assistive Handgrips
	• Adjustible seating
	• Biomechanically designed pedals
	• METs-Based Training for Consistent Workload
	• Preset workout programs
	• Smart Heart Rate Control
	  ▪ Adjusts resistance automatically
	  ▪ Clinicians can assign heart rate goals
		• Ergonomic Handlebars
		• Robost Folding Hinge
		• Chain protection tubes
		• Disc brakes
		• Easy wheel removal
		• Suspension
		• Custom Features (Add-ons):
		  ▪ Ergonoic seats, rear rack, mudguards, parking brakes, weather protection gear, electric-power assist
			• Durable construction
			• Performance Monitor
			• Easy Assembly
			• Using air resistance
			• East storage and mobility

CONS	• Expensive • Digital features seem overwhelming for beginners • Easy to use with supervision from clinician • Difficulty assembling • Only one type of exercise	• Expensive • Digital features seem overwhelming for beginners • Easy to use with supervision from clinician • Difficulty assembling • Only one type of exercise	• Significant technique learning curve • Increases injury risk when skipped • Space and noise requirement • Can strain on back and wrists • People with pre-existing knee injuries may find uncomfortable

Table 1: Product Table Matrix of Recumbent Exercise Equipment

1.3.6 Strength Training & Core Exercises

The most expensive and innovative equipments that could be found in the market of the respective strength training and core exercise equipment was used as a fair comparison.

PRODUCT	4	5	6
	FITLAB SEATED LEG PRESS	FFITTECH SUPPORTED SEAT ROW	ATTIVO BACK EXTENSION BENCH
	 (Elite Fitness Equipment, n/a)	 (FFITTECH, n.a)	 (Auchoice, n/a)
DESCRIPTION	Leg presses are a seated leg exercise where your feet are placed flat on a weighted platform, and you push the weight away from you. (Nike, 2026) **$3,959 -$255 | 128kg | 2130 x 1090 x 1710 mm**	"The Seated Row is a commercial-grade solution for developing a strong, muscular back while maintaining proper posture and stability. Designed to deliver biomechanically sound, efficient pulling motion, it's ideal for high-performance training environments including home gyms, PT studios, hotels, and commercial facilities." (FFITTECH, n.a) **$3,099 -$380 | 120kg | 1260 x 1170 x 1460 mm**	"A back extension bench, often called a back extension machine, uses gravity as resistance. It requires you to face the floor with your thighs on the pad, letting your spine extend upward" (Healthline, 2024) **$360 -$143 | 17kg | 356 x 610 x 2438 mm**
TARGET		 (Ronai, 2019)	 (Auchoice, n.a)
FEATURES	• Dual-functionality: Leg Press and Calf raise • Space to store phone and water bottle • 100kg weight stack, optional 156kg weight stack • Ergonomic seating and back rest	• Enhances upper body strength and posture • 100kg weight stack • Steel weights • Electrostatic power-coated frame • Nylon-coated cables • Sealed bearing nylon pulleys • Adjustible seat and chest pad • Rubber feet	• Version 2.0 upgrade: Wide and sturdy steel foot plate, which enhances safety during your hyperextension and core workout. • Constructed of 2" x 2" 12-gauge steel with a stable base. • 6 x Adjustable positions with locking pins for an 25cm ranges of motion. (Auchoice, n.a)
CONS	• Can strain back and joints without proper form • Not portable • Expensive • Difficulty assembly	• Not portable • Expensive • Significant technique learning curve	• Significant technique learning curve • Hard to track progress • Storage • Higher lower back injury risk

Table 2: Product Table Matrix of Strength Training & Core Exercises

1.3.7 Flexibility & Balance

The most expensive and innovative equipments that could be found in the market of the respective Flexibility and Balance exercise equipment was used as a fair comparison.

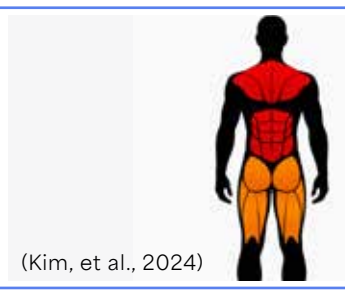
	7	8	9
PRODUCT	IVORY REFORMER	BLACKROLL GYMBALL	CENTRA YOGA MAT
	 *(Elite Fitness Equipment, n/a)*	 *(FFITTECH, n.a)*	 *(Auchoice, n/a)*
DESCRIPTION	The reformer is a Pilates apparatus that consists of a sliding carriage attached to adjustable springs, ropes, and pulleys. It is designed to provide resistance-based exercise that improves strength, flexibility, balance, coordination, and core stability.	The GYMBALL was specifically developed for use in functional training. Whether you're doing coordination and stability training or working out with additional weights (Keep on Running, n.a)	A yoga mat is a specialized non-slip and cushioned surface designed to provide traction, stability, and support during the practice of yoga postures and floor exercises (Trx Training, n.a)
	$2499 -$165 | **90kg** | **2440 x 680 x 280 mm**	**$60 -$9** | **1kg** | **650 mm**	**$114 -$25** | **1.1kg** | **1720 x 610 x 5 mm**
TARGET	 (Kim, et al., 2024)		
FEATURES	• Aluminium allow and steel frame • Folds in half and can stand upright: Storage • Adjustible footbar, headrest, jumpboard • Hand and foot straps • Multiple pilates exercises	• Capacity up to 500kg • Training equipment and sitting ball in one • Odor-neutral, elastic	• Alignment stripe • Reversible • Seals out sweat • Latex free • Can do multiple types of exercises • Easy to store • Affordable
CONS	• Expensive • Significant learning curve • Space requirement • Intimidating for beginners • Risk of injury	• Storage • Risk of falling • Lack of support	• Joint discomfort • Wear and tear • Stability • Does not absorb the shock of jumping

Table 3: Product Table Matrix of Flexibility & Balance

1.3.8 Recumbent Criterias

PRODUCT	AVAILABILITY	MANUFACTURING	PORTABILITY	STORAGE	AESTHETICS	ERGONOMICS & EASE OF USE	TOTAL
1. RECUMBENT BIKE INDOOR	4	1	2	2	5	3	15
2. RECUMBENT BIKE OUTDOOR	3	1	3	2	3	3	15
3. ROWER	3	4	2	4	4	4	20

Table 4: Recumbent Exercise Comparison Table

Based on Table 4, there is a clear gap in manufacturing, portability, and storage across both types of recumbent bikes due to the specialised technology and components required to build them. These limitations create financial and accessibility barriers for people who rely on recumbent equipment. However, recumbent bikes remain strong in aesthetics, offering an inviting and supportive environment for users.

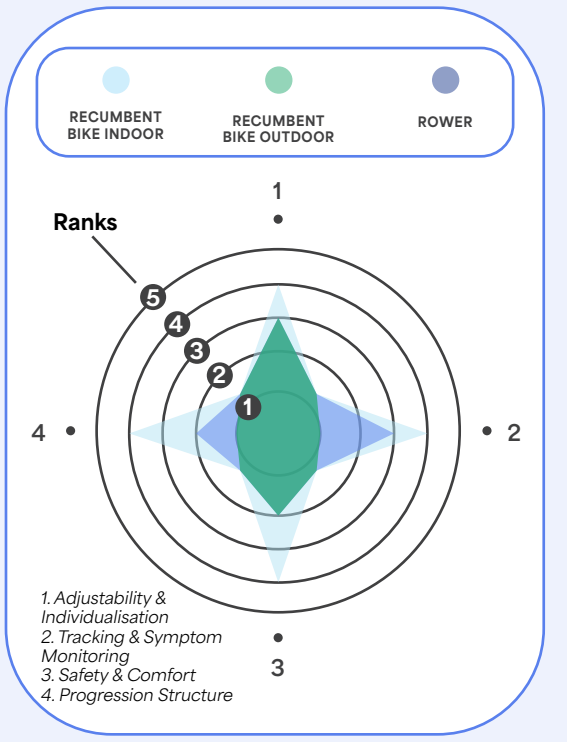


Figure 2: Recumbent Exercise Spider Graph

Based on Figure 2, the indoor recumbent bike scores highly because it is purpose-built for POTS and includes supportive technology. The outdoor recumbent bike cannot incorporate this technology due to exposure risks, which limits its effectiveness despite being less expensive.

1.3.9 Strength & Core Criterias

PRODUCT	AVAILABILITY	MANUFACTURING	PORTABILITY	STORAGE	AESTHETICS	ERGONOMICS & EASE OF USE	TOTAL
4. SEATED LEG PRESS	2	2	1	1	3	2	11
5. SEATED ROW	2	2	1	1	3	1	10
6. BACK EXTENSION	4	4	3	3	2	1	17

Table 5: Strength & Core Comparison Table

Based on Table 5, portability and storage score very low for the seated leg press and seated row due to their bulky builds, making them difficult to use in home-based exercise settings. Ergonomics and ease of use also score poorly across all equipment, as these exercises typically require proper supervision to ensure safe and effective performance.

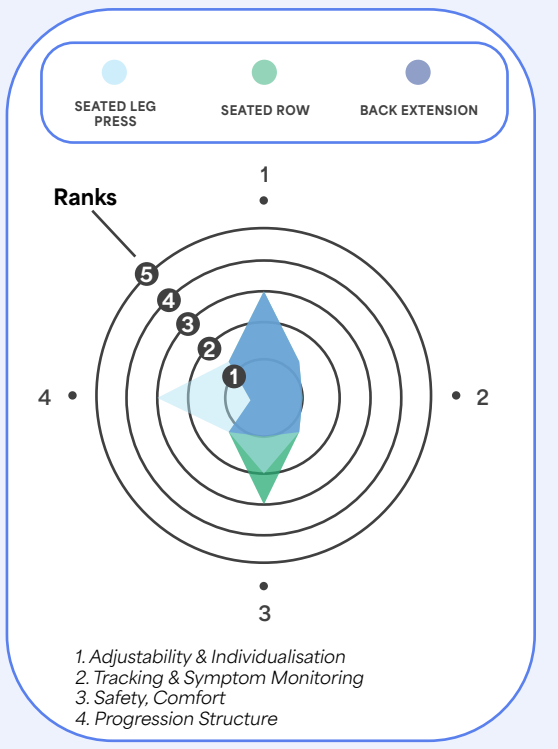


Figure 3: Strength & Core Exercise Spider Graph

In Figure 3, there is an exponential gap in tracking & symptom monitoring, this could be due to the cost of incorporating that technology, and that the market of these products is also for able-bodied individuals.

1.3.10 Flexibility & Balance Criterias

PRODUCT	AVAILABILITY	MANUFACTURING	PORTABILITY	STORAGE	AESTHETICS	ERGONOMICS & EASE OF USE	TOTAL
7. REFORMER	3	2	2	2	4	1	14
8. SEATED BALL	5	5	5	4	3	3	25
9. YOGA MAT	5	5	5	5	4	4	28

Table 4: Flexibility & Balance Exercise Comparison Table

Across the board, the seated ball and yoga mat has scored very high, this is due to its size and accessibility, however, with the reformer has scored low in terms of general design due to how difficult it is to manufacture and move.

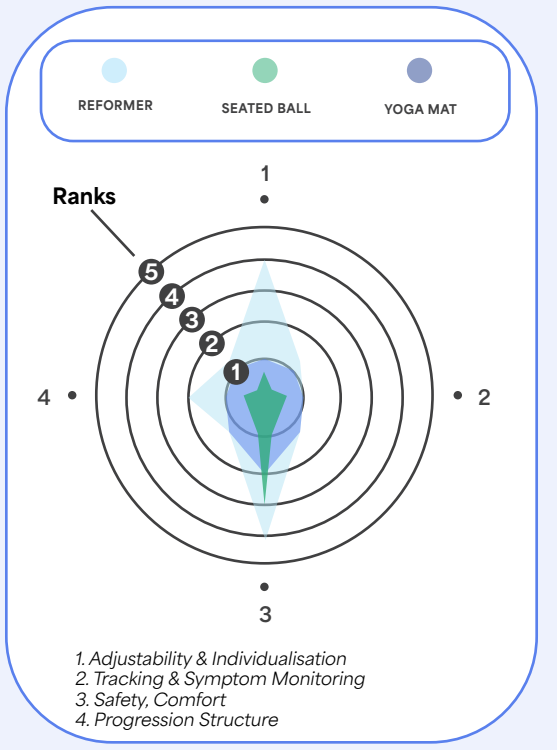


Figure 4: Strength & Core Spider Graph

Although in Table 4 the seated ball and yoga mat has scored high, in Figure 4, it lacksmost of what POTS experts want in exercise rehabilitation. Finding balance between accessibility and POTS technology is needed.

1.3.6 Emotional Connection Benchmarking

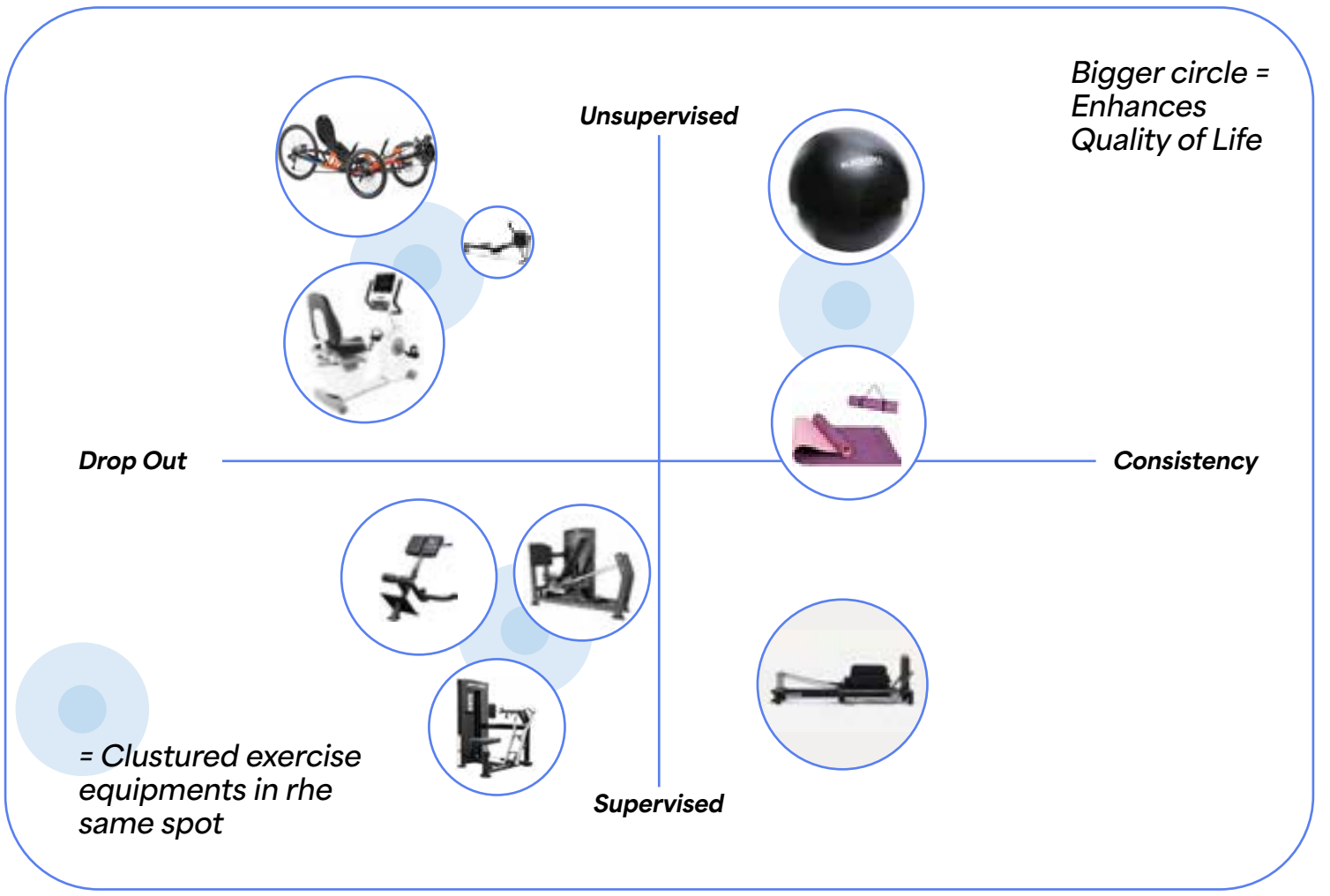


Figure 5: Evaluation of POTS rehabilitation exercise products against drop out rates and supervision

1.3.6 Opportunities and Gaps

1. The **recumbent exercise** equipment results indicate that even when experts strongly recommend a product, it is only effective if the user is willing to engage with it, as shown in Figures 2 and 5. The indoor recumbent bike includes symptom-tracking technology, but its multiple features and static movement may contribute to higher dropout rates. It is worth noting that these user-experience insights are based on a single case study.

2. **Strength-training and core** equipment score significantly lower than recumbent and flexibility/balance options across all criteria. These devices are often bulky, intimidating for beginners, and lack progression structures suitable for POTS rehabilitation. This misalignment shows that most strength-training products are not designed with autonomic limitations or symptom variability in mind, ultimately contributing to higher dropout rates.

3. The **flexibility and balance** equipment show the opposite pattern to the recumbent category. Although these products are easy to manufacture, widely accessible, and suitable for unsupervised training, they make it difficult to track progress or monitor symptoms. As shown in Figure 4, most of these products score very low across the POTS-specific criteria, meaning they are not strongly recommended by experts. The reformer is a notable exception, meeting many of the Figure 4 criteria, but it requires greater supervision according to Figure 5.

1.3.6 Summary

In turn, these gaps allow for a space to create both an accessible and a expert recommended solution. Products that incorporate, unsupervised training, yet being user-friendly, portability and innovative. The benchmarking findings establish a foundation for the primary research to be compared to, the following section will forefront end user's experiences and expert opinions.

02

THE RESEARCH

2.1 Research Overview

2.2 Methodology

2.3 Analysis & Findings

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Research Framework

Interview

1

- Question Structure split into two, people who exercise and don't
- Semi-structured interviews
- Conducted both in person and through Zoom
- Interviews were transcribed through Voice Memos and Zoom

Survey

2

- Two types, one for researchers and one for practitioners
- Created on Google Forms for participant anonymity
- Link was emailed to every clinician on the "The POTS Foundation: Clinician Directory"

Analysis

3

- For surveys, Qualitative and Quantitative data was analysed
- For Qualitative results thematic coding and an Affinity Diagram was created
- For Quantitative results statistical analysis was applied

Figure 6: Visual Diagram of the Research Framework

2.1 Research Overview

This section highlights the methodology used to gather the primary research, as well as a visual representation on the primary data using various analytical methods. This is to gain in depth insights on end users and experts who live or specialise in POTS.

2.2 Methodology

A triangulation approach was used to ensure high research quality, drawing on multiple methods within the study to extract the necessary information and critically analyse the findings, this includes a survey and interviews. This integration of approaches enhances the overall validity and credibility of the results, as supported by Bans-Akutley & Tiimub (2021).

Online research (Seen in Section 1.2) consisting of data, recommendations and case studies were used to create the questions for the survey,

2.2.1 Interview Method

PURPOSE

The purpose of the semi-structured interviews is to understand experiences of **people living with POTS, specifically on exercising and daily life**. This way, gaps and opportunities will be identified.

METHODS

The interviews were semi-structured, to ensure there is open ended data to gather, it is specifically useful in health services research. It is particularly useful in establishing trust and rapport, memoing and reflection and analysing data (DeJonckheere & Vaughn, 2019). Lastly, the 4 interviews produced qualitative data as it only contained open-ended questions.

A total of four participants were interviewed (see Figure 7), using eight questions, seven open-ended and one yes/no (see Appendix 3 for the interview guide). The interview flow was adjusted depending on whether the participant was physically active, ensuring their responses were grounded in actual exercise experience rather than assumptions (see Figure 7).

4 PARTICIPANTS

RECRUITMENT

Occurred through existing social connections and peer referrals.

LIMITATIONS

- There is a possibility that some statements within the transcripts may be unclear or difficult to interpret, which may affect the accuracy of meaning during analysis.
- Interview questions varied slightly depending on whether the participant engaged in exercise (see Appendix 2), which may introduce minor differences in the depth or direction of responses.
- Some participants may have felt uncomfortable discussing personal or health-related topics, limiting openness
- One participant had a pre-existing relationship with the researcher, resulting in extended engagement during the interview process
- As three participants were within the same age group, which may have contributed to a higher frequency of specific themes
- Neurodivergence was present in three of the four participants, which may have contributed to a higher frequency of specific themes

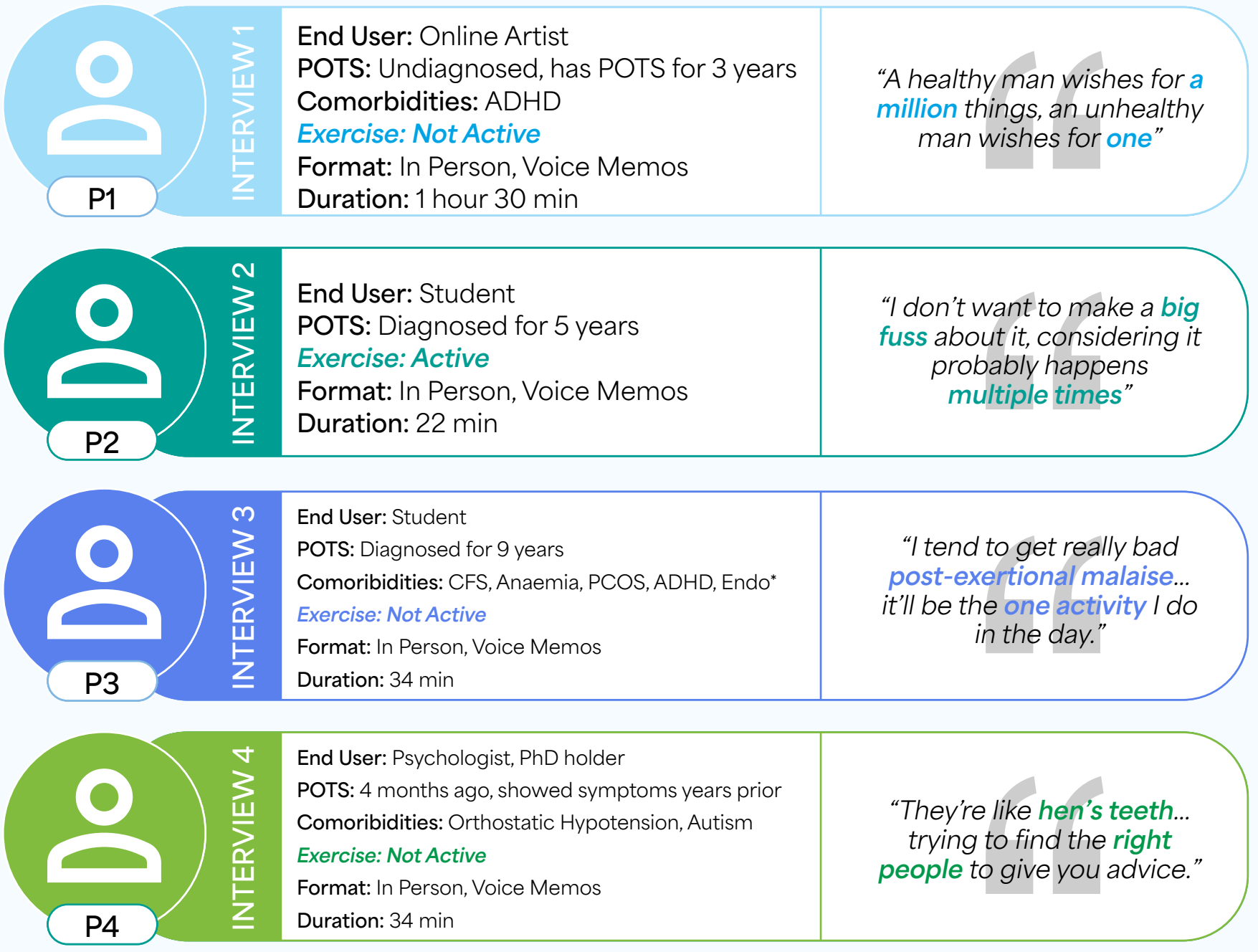


Figure 7: Interview Participant Description

2.2.2 Participant Justifications

It was important to engage with a diverse range of people living with POTS, specifically, people undiagnosed, having comorbidities, physically active and unactive, and lastly age to gain different perspectives on their experiences with POTS. Especially since POTS is not one size fits all. The main topics of these interviews was to gain an understanding on products they use, and what they would like in the context of exercise or what they have, depending on if they are physically active.

As one participant has a pre-existing relationship with the researcher, the time of the interview was tripled to allow for an insightful and valuable interview. The interview allowed for additional questions to be asked and feedback whether more questions should be introduced.

2.2.3 Survey Method

PURPOSE

The purpose of the survey is to understand experts both practitioner and researcher's experiences working or researching people living with POTS to understand the gaps and opportunities.

METHOD

Survey research enables flexible participant recruitment, diverse data-collection methods, and the use of both quantitative and qualitative instrumentation. It incorporates quantitative strategies such as checkbox items and qualitative strategies such as open-ended questions, allowing researchers to gather information efficiently (Ponto, 2015). Given the aim of understanding expert insights into POTS rehabilitation, the survey was the most effective method for capturing equipment use in clinical environments, identifying industry pain points, and exploring future directions.

The survey was intentionally designed on Google Forms to collect both qualitative data and quantitative data, as combining these forms provides a more complete picture of practitioner perspectives (Australian Bureau of Statistics, n.a.). It consisted of ten questions: five categorical items capturing participant background and checkbox selections, and five open-ended questions. Research shows that open-ended responses reveal underlying reasons, feelings, and contextual factors behind participant choices (Albudaiwi, 2018).

Two versions of the survey were created, one for researchers and one for practitioners, to ensure all POTS exercise experts could participate. While the content of the questions remained identical, the layout was adjusted to suit each group's professional context.

23 PARTICIPANTS

RECRUITMENT

Emailed 300+ practitioners on "The POTS Foundation: Clinician Directory"

LIMITATIONS

- As both surveys were sent to every participant, there is a chance that the participant had done both surveys.
- Some Individuals in the survey may represent the characteristics of the required participant, if they do not have the required expertise. (Ponto, 2015)
- Measurement error, questions do not accurately reflect the topic of interest (Ponto, 2015)
- Questionnaire do not evoke truthful answers (Ponto, 2015)
- Difficulty to tell emotion behind an answer

Recruitment was not only through the "The POTS Foundation: Clinician Directory" but through the Active Health Clinic Support Program (Active Health Clinic, n.a). A consultation with an expert had taken place, to support the outreach of the survey.

2.3 Analysis & Findings

Conceptual analysis were mainly utilised to interpret the open-ended questions data collected for both the interview and survey, where a thematic analysis approach was used. From the categories and themes indentified, it created the foundation on the design implications.

2.3.1 Interview Analysis

A thematic analysis was conducted using Braun and Clarke's six-phase framework, which supports identifying and interpreting shared meanings and experiences within qualitative data (Braun & Clarke, 2006). The interview transcripts recorded through Apple Voice Memos were printed and manually highlighted to capture key words, pain points, and insights. These highlighted segments were then transferred digitally into Miro, where recurring patterns began to form five preliminary themes. In the next stage, the sticky notes were organised by theme and separated into "positive" and "negative" categories, allowing the analysis to focus on both supportive and problematic aspects of participants' experiences. This structure ensured that the final themes reflected not only what participants valued but also the barriers and challenges they encountered. Due to the amount of codes, there were no subcategories.

In total, there were 5 themes: (1) Compromise, (2) Awareness, (3) Support, (4) Motivation and (5) Accessibility and 344 codes identified.

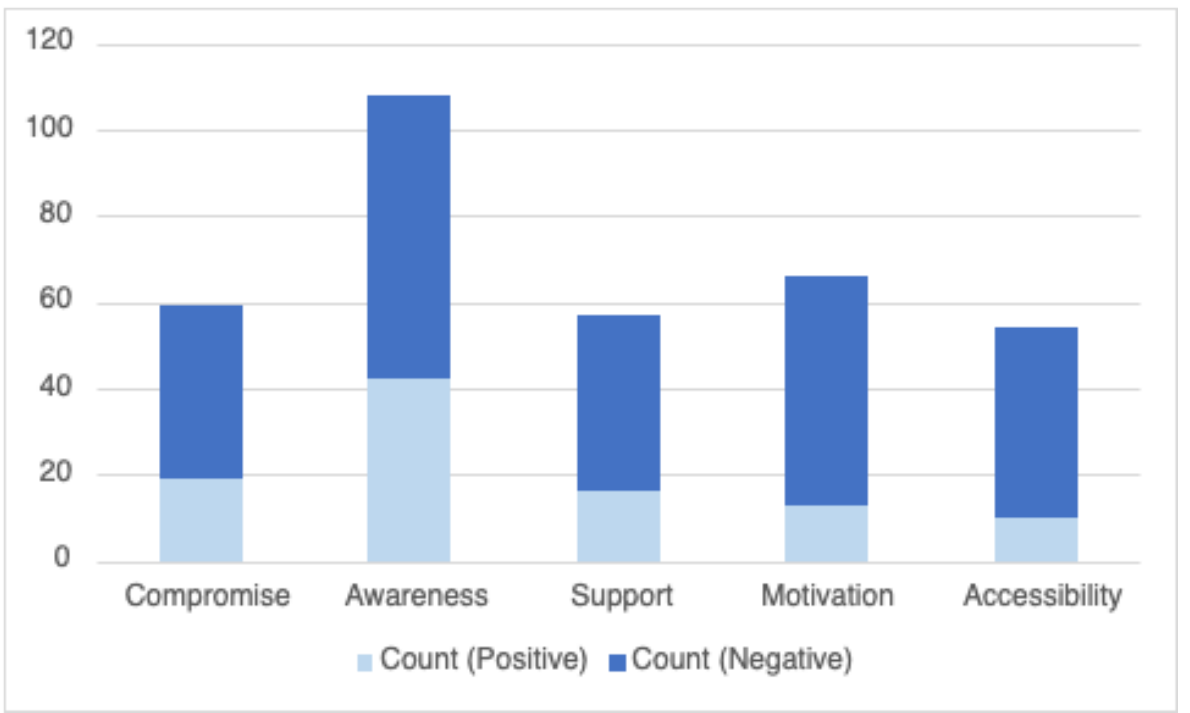


Figure 8: The overall count of the interview thematic analysis

2.3.2 Thematic Analysis of Emerging Themes

Compromise

Compromise was a common theme across the four interviews, mentioned 59 times, 19 in a positive context and 40 in a negative context. Within this theme, participants described how their time, energy, education, and interests were consistently compromised while living with POTS. This could mean that daily decision-making is shaped around symptom management rather than personal preference, leading individuals to prioritise stability over activities they value.

Awareness

Awareness was another common theme across the four interviews, mentioned 108 times, 42 in a positive context and 66 in a negative context. Participants described how difficult it was to access certain information, understanding what certain flares is triggered by what (especially if the have comorbid conditions). The almost balanced positive and negative codings indicate that the participants are accessing more information online and through communities, but there is still more accessibility to information needing to be done.

Support

Support was mentioned a bit less than most of the themes, with the amount being 57, 16 in a positive context and 41 in a negative context. Participants mainly described the difficulty it was to get reliable support, especially from doctors, one participant mentioning a doctor told them, “That’s normal, you seem fine”. As mentioned in Section 1.2, there are many doctors who lack training with POTS. Therefore, these interactions can diminish an individual’s confidence and seeking proper help.

Motivation

Motivation was mentioned 66 times, 13 in a positive context and 53 in a negative context. Participants described how their symptoms made it difficult to stay motivated, particularly for those who were not currently exercising. Concerns were raised about exercises that did not align with personal preference, as illustrated by Participant 4’s comment: “I couldn't stand the idea of spending 4 months on a recumbent bike, then you transition, level up, and I thought, I'm never going to do this.” This suggests that motivation is strongly influenced by whether an exercise feels meaningful, enjoyable, or personally compatible. When an activity lacks emotional connection or feels burdensome, users are less likely to engage consistently, which may contribute to higher dropout rates and reduced adherence to rehabilitation programs.

Accessibility

Accessibility was mentioned the least across the five themes, appearing 54 times–10 in a positive context and 44 in a negative context. Prominent concerns in this theme included the cost of classes, exercise equipment, and gym memberships, as well as travel constraints. Because of the large difference between positive and negative codes, it suggests that accessibility remains a significant barrier to consistent exercise participation for people with POTS.

2.3.3 Survey Analysis

Similar to the interview, a thematic analysis approach was conducted. Once the responses were recorded on Google Forms, it was then coded through Taguette, a software you can digitally code data. Once the numbers were collected, a visual graph was created to show the code count of each theme.

As mentioned in Section 2.2.3, the survey collected qualitative and quantitative data. The Quantitative Data was analysed with its, highest percentage and was compared to other questions with a Bivariate Analysis Method.

In total, 3 themes, 60 sub-categories and 546 codes were found.

2.3.4 Survey Responders

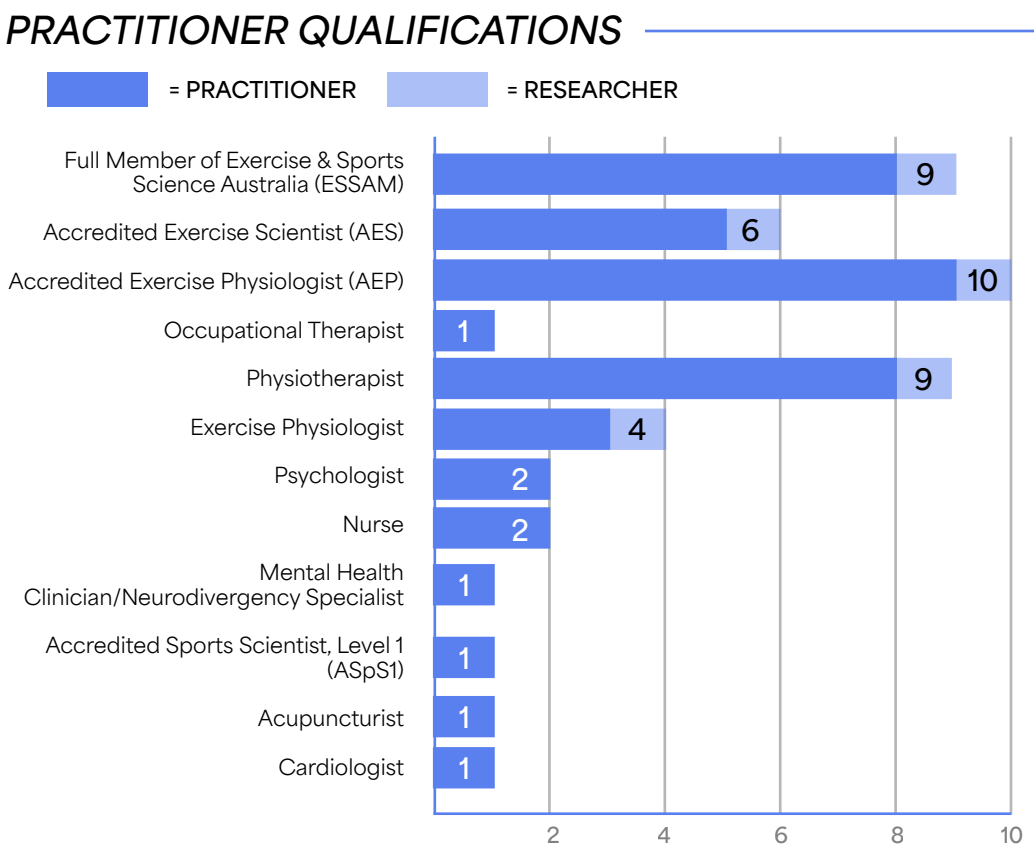


Figure 9: Graph of responses for Background Question 1 of the survey

Of the 28 experts, the largest groups were in the exercise field including, ESSAM (19%), AEP (21%) and Physiotherapist (21%).

In terms of Education Qualification, the largest groups include experts with Undergraduate Degrees (46%) and Master's Degrees (38%). This could be due to the time constraints of clinicians with more educational qualifications.

Lastly, the largest groups on Years of Experience are responders with 2-4 years (33%) and 5-10 years (37%).

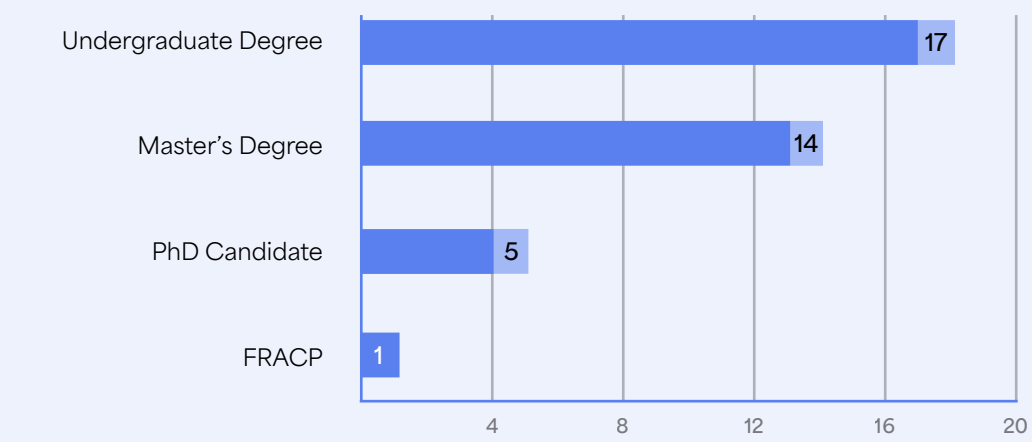


Figure 10: Graph of responses for Question 1 of the survey

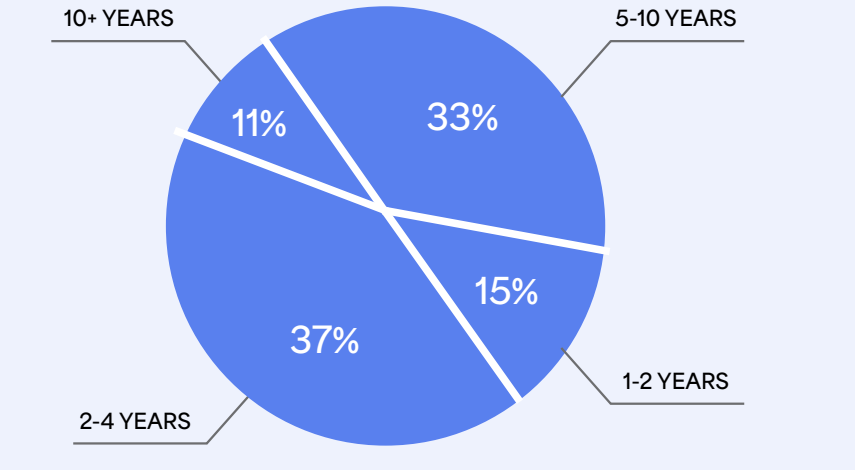


Figure 11: Graph of responses for Question 1 of the survey

2.3.5 Survey (Quantitative Data)

1. WICH EXERCISE DO YOU USE/RECOMMEND FOR POTS REHABILITATION?

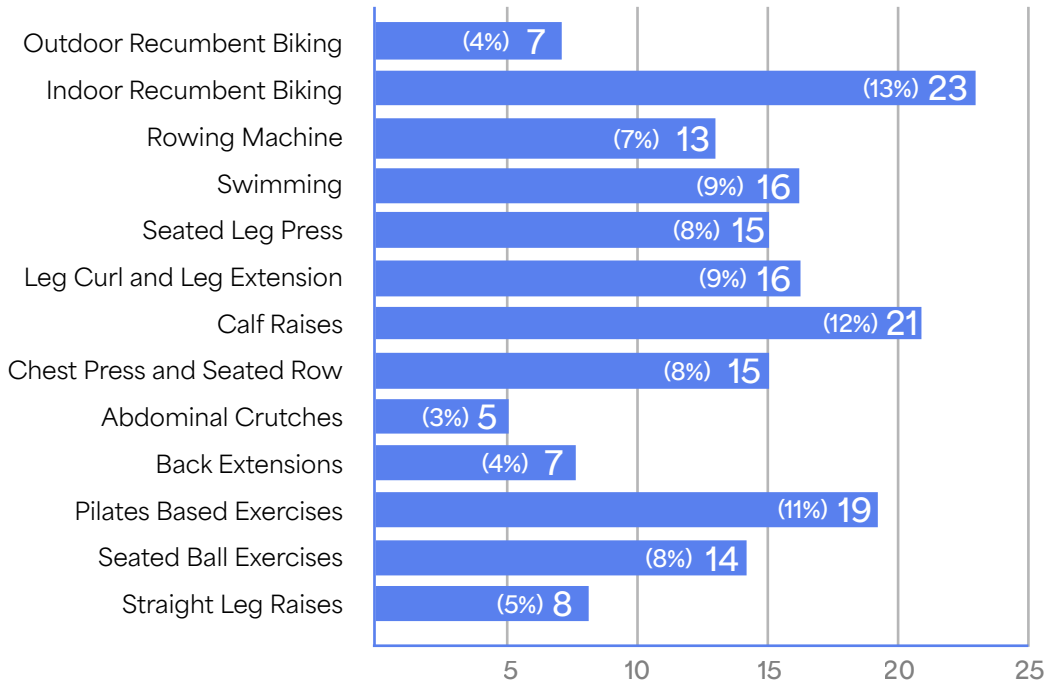


Figure 12: Graph of responses for Questionnaire Question 1 of the survey

Based on Figure 11, in the "other" section, the responses were noting on some limitations of certain exercises, and repeated notes, see Appendix 2 for more details.

The most amount of votes are "Indoor Recumbent Biking" with 13% and "Calf Raises" with 12%. This could be due to the amount of secondary research corroborating with both exercises.

1. WHICH EXERCISE DO YOU USE/RECOMMEND FOR POTS REHABILITATION?

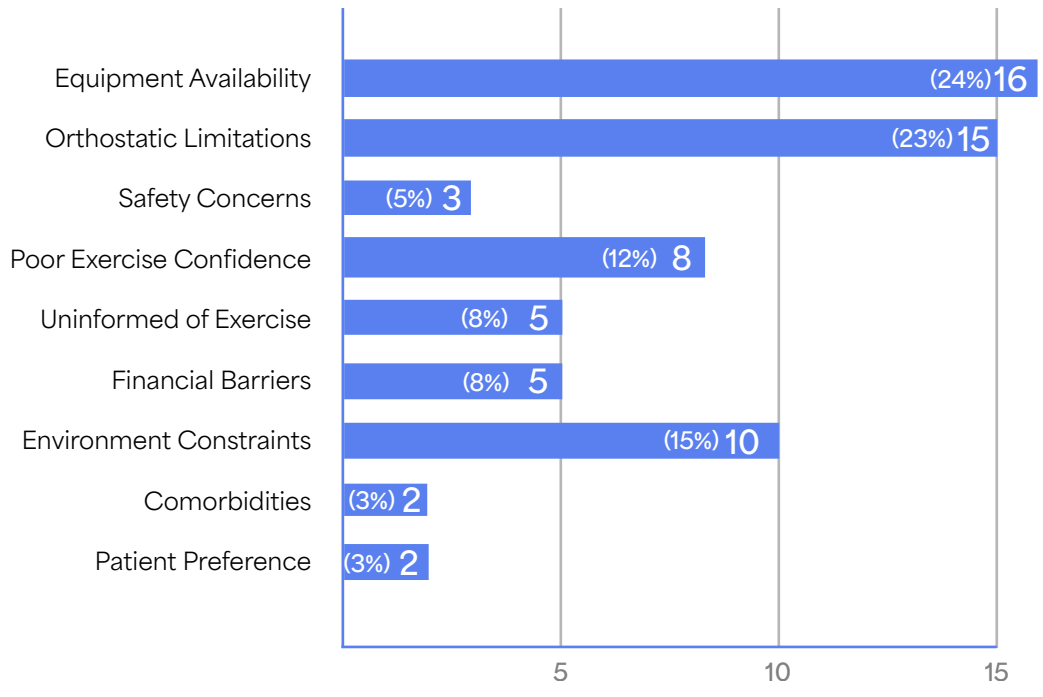


Figure 13: Graph of responses for Questionnaire Question 2 of the survey

The most amount of votes are "Equipment Availability" with 24% and "Orthostatic Limitations" with 23%. This could be due to what the benchmarking had shown how the hards to manufacture products are difficult to get, additionally, since POTS is not the same for everyone, this impacts orthostatic limitations.

The next section of the survey focuses on the open-ended questions, specifically on specific pain points, opportunities and implications of exercise rehabilitation for people living with POTS.

2.3.6 Survey (Qualitative Data)

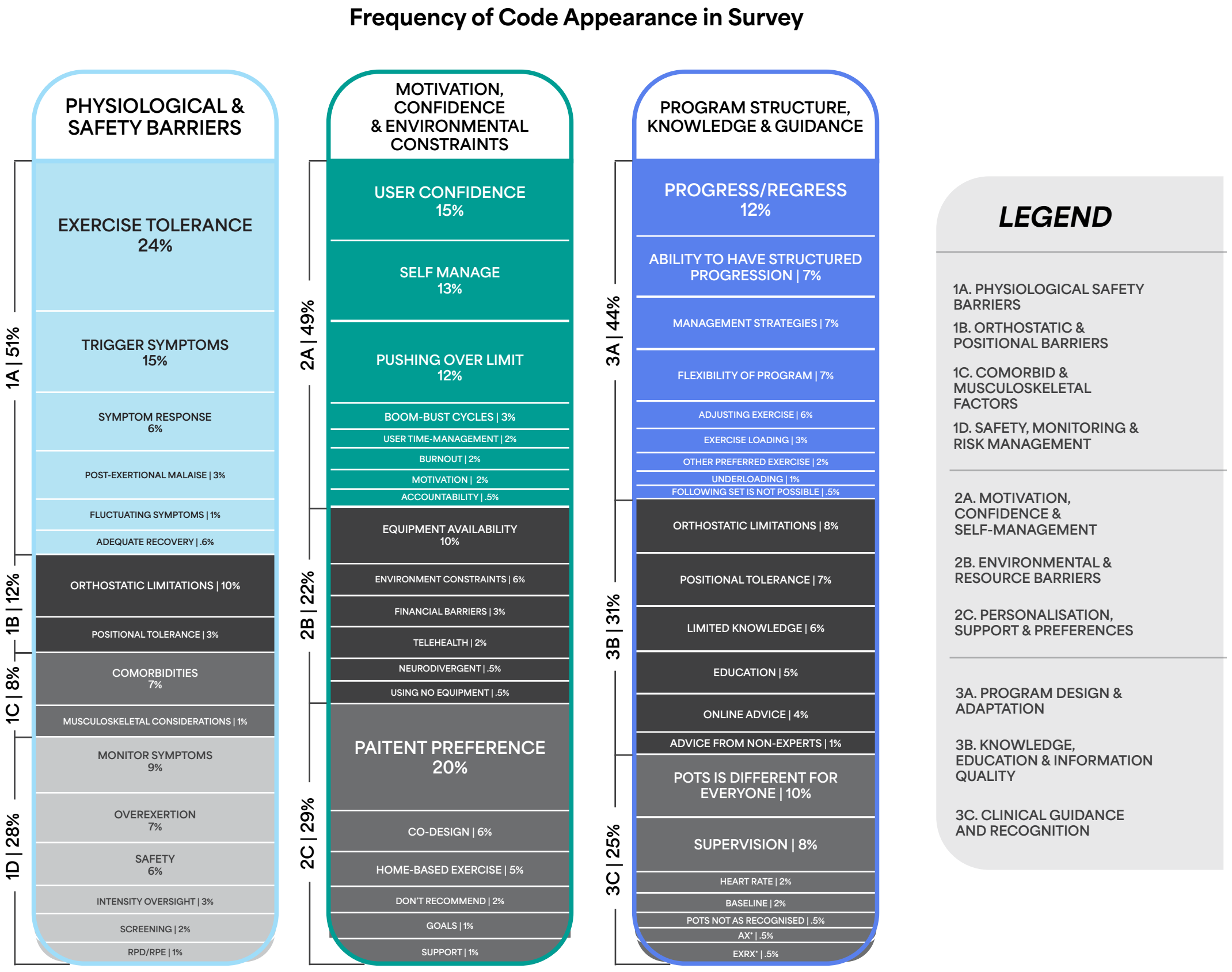


Figure 14: Tree Chart displaying the frequency of codes in survey responses

The percentage is based on the how much it is mentioned in its respective category. For example, "Exercise Tolerance" is 24% of the overall amount of times "Physiological & Safety Barriers" is mentioned in the survey.

From the Tree Chart in Figure 13, it is clear that several concepts carry significant weight in shaping POTS-specific exercise experiences. The most prominent of these is exercise tolerance, which reflects an individual's ability to manage symptoms while engaging in physical activity. Closely connected is patient preference, highlighting the importance of aligning exercise modalities with what users feel comfortable, motivated, and willing to engage with. User confidence also emerges as a critical factor, indicating that individuals are more likely to participate consistently when they feel capable, supported, and safe during exercise. Finally, progression and regression underscore the need for adaptable programs that respond to fluctuating symptoms and allow users to advance or step back without feeling discouraged. Together, these concepts point to a community emphasis on personalised, flexible, and symptom-responsive exercise pathways that support long-term adherence and reduce dropout.

2.3.7 Summary

In turn, these gaps allow for a space to create both an accessible and an expert recommended solution. Products that incorporate, unsupervised training, yet being user-friendly, portability and innovative. The benchmarking findings establish a foundation for the primary research to be compared to, the following section will forefront end user's experiences and expert opinions.



DISCUSSION

3.1 Discussion

3.2 Design Implications

3.3 Conclusion

Nicole Mangila

3.1 Discussion

What does it all mean?

Across the benchmarking, interviews, surveys, and literature review, a clear and consistent theme emerges: exercise rehabilitation for people with POTS is shaped by a complex interaction between physiological limitations, personal preference, confidence, accessibility, and the adaptability of the exercise itself. Each data source reinforces this conclusion from a different angle, demonstrating why current exercise pathways often fail and where design opportunities exist.

There wre many connections from my literature research to my primary research, these include:

POTS symptoms fluctuate daily and are highly individual. The interviews confirm this, with participants repeatedly describing how their time, energy, and interests are compromised by symptom management. Benchmarking shows that equipment requiring upright posture or high exertion scores poorly across POTS-specific criteria, and survey results highlight orthostatic limitations as one of the most significant barriers. Together, these findings show that exercise tolerance is the foundation upon which all other decisions are made, if an exercise exceeds someone's physiological capacity, dropout becomes inevitable.

The difference in opinions to recumbent biking. Survey data shows experts frequently recommend recumbent biking and calf raises, interviews reveal that users may reject these exercises if they feel boring, burdensome, or misaligned with personal preference. Participant 4's statement about the recumbent bike illustrates this clearly. Benchmarking also shows that even highly recommended equipment (e.g., recumbent bike) can fail if users do not feel motivated or emotionally connected to it. This aligns with literature emphasising the need for individualisation.

Interview themes show that confidence is repeatedly undermined by poor medical support, lack of guidance, and uncertainty about symptom triggers. Benchmarking reinforces this: equipment that is bulky, intimidating, or difficult to use (e.g., strength-training devices) scores poorly. Survey responses also highlight equipment availability and usability concerns. Confidence acts as a gateway, without it, even accessible exercises become psychologically inaccessible.

These findings add knowledge to identified research gaps as they corroborate certain topics, and justify the decisions during the design development stage.

3.2 Design Implications

After reviewing the findings, many key pain points were discovered, this in turn produced five opportunities for POTS exercise rehabilitation.

Opportunities

1. **Adaptability:** People with POTS experience highly variable symptoms day-to-day, meaning a fixed exercise plan often becomes unusable. Designing for adaptability ensures that activities can scale up or down depending on fatigue, dizziness, or flares, reducing dropout and supporting safer long-term participation.

2. **Preference:** Based on the interviews and surveys users are more motivated when exercises align with what they enjoy or feel comfortable doing. Prioritising preference helps create emotionally meaningful exercise experiences, improving adherence and reducing frustration with activities that feel boring, burdensome, or mismatched.

3. **Confidence:** Participants repeatedly described low confidence due to unclear guidance, intimidating equipment, and inconsistent medical support. Designing for confidence means providing simple instructions, reassurance, and beginner-friendly pathways that help users feel capable, safe, and supported.

4. **Progression:** Symptoms fluctuate, and users need the ability to progress or regress without feeling discouraged. Building in progression ensures that exercise pathways remain flexible, allowing users to advance when stable and step back during flares while still maintaining momentum.

5. **Accessibility:** Financial barriers, travel limitations, and equipment availability were major concerns across all data sources. Prioritising accessibility means creating affordable, portable, and home-friendly solutions that reduce reliance on gyms, expensive devices, and long travel times.

3.2 Conclusion

POTS is not the same for everyone, and although there are many ways to manage it, exercise rehabilitation remains one of the most effective strategies for improving functional capacity and long-term symptom stability. Across the benchmarking, literature, interviews, and surveys, this report demonstrates that successful rehabilitation depends on more than prescribing the “right” exercise; it requires understanding the lived realities of people with POTS and the people who help treat it.

The findings show that exercise tolerance, patient preference, confidence, progression, and accessibility are the core factors shaping whether individuals can engage with exercise safely and consistently. These concepts appear repeatedly across all data sources: users compromise time and energy to manage symptoms, struggle to access reliable information, face inconsistent medical support, lose motivation when exercises feel mismatched, and encounter financial and logistical barriers that limit participation. Although it is a hidden disability, it impacts many aspects of daily life, and exercise rehabilitation represents one meaningful pathway toward improving independence, stability, and quality of life

04

END

4.1 *Reference List*

4.2 *Appendix*

Nicole Mangila

4.1 Reference List

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