

# 10 APPENDIX

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A PROJECT BRIEF

DESIGN  
FOR our  
future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

**USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT**  
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

**STUDENT DATA & MASTER PROGRAMME**  
Save this form according the format "IDE Master Graduation Project Brief\_familyname\_firstname\_studentnumber\_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name

initials

given name

student number

street & no.

zipcode & city

country

phone

email

Your master programme (only select the options that apply to you):

IDE master(s):

IPD

Dfl

SPD

2<sup>nd</sup> non-IDE master:

individual programme: - - (give date of approval)

honours programme:

specialisation / annotation:

**SUPERVISORY TEAM \*\***  
Fill in the required data for the supervisory team members. Please check the instructions on the right !

\*\* chair

dept. / section:

\*\* mentor

dept. / section:

2<sup>nd</sup> mentor

organisation:

city:

country:

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.



Procedural Checks - IDE Master Graduation

**APPROVAL PROJECT BRIEF**  
To be filled in by the chair of the supervisory team.

chair Arien Jansen date - - signature

**CHECK STUDY PROGRESS**  
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: EC

Of which, taking the conditional requirements into account, can be part of the exam programme EC

List of electives obtained before the third semester without approval of the BoE

YES

all 1<sup>st</sup> year master courses passed

NO

missing 1<sup>st</sup> year master courses are:

name date - - signature

**FORMAL APPROVAL GRADUATION PROJECT**  
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked \*\*. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?

Is the level of the project challenging enough for a MSc IDE graduating student?

Is the project expected to be doable within 100 working days/20 weeks ?

Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content:

APPROVED

NOT APPROVED

Procedure:

APPROVED

NOT APPROVED

comments

name date - - signature

Design an optimized backpack for women project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 23 - 09 - 2022 10 - 02 - 2023 end date

INTRODUCTION \*\*

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The client specializes in high-quality sportswear and sport equipment. Their aim is to provide customers with the highest level of comfort and fit for each product which led to various product collections. Everyday consumer backpacks are designed for a wide percentile of the public while being affordable. Specifically for this project, the focus is to develop an optimized backpack for women as part of the Collection, which is a collection with products that is designed, developed, and curated for women. The desire for such product is to better account for the gender differences in terms of anthropometrics and ergonomics. The vast difference can be seen based on the build of men versus women especially in the torso, shoulder, and hips areas. These are the targeted areas of improvement for the backpack that will prevent long term discomfort for fast-hiking.

The main opportunities of this project are the resources made available by the client in terms of prototyping capabilities, networks, and working alongside the Research and Innovation(R&I) and Backpack Development (BD) team. Additionally, I can take advantage of what the faculty of IDE has to offer for anthropometric data, 3D scanning, the PMB, and experts within the faculty. A limitation of this project is the amount of time consumed for the shipment of prototyping goods and samples from the client they are not based in Delft. In addition, all communication will have to be remote.

The stakeholder involved are as follows,

- User group: Those who do fast hiking on an amateur or expert level, who is looking for an ergonomically backpack that is fitting and aesthetical.

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introduction (continued): space for images

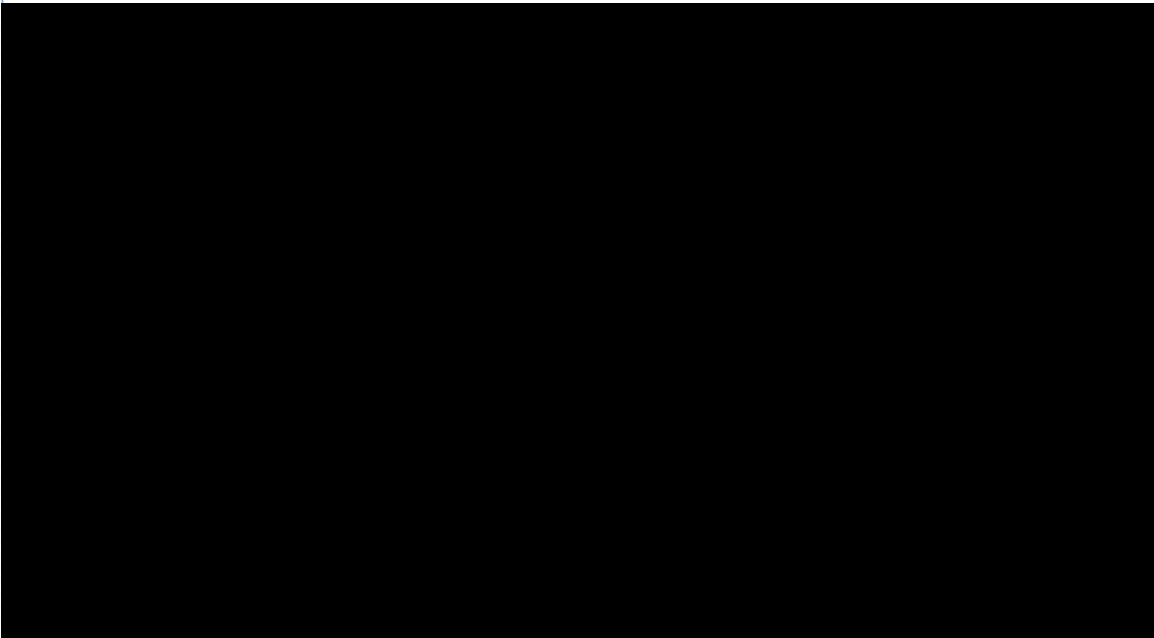


image / figure 1:

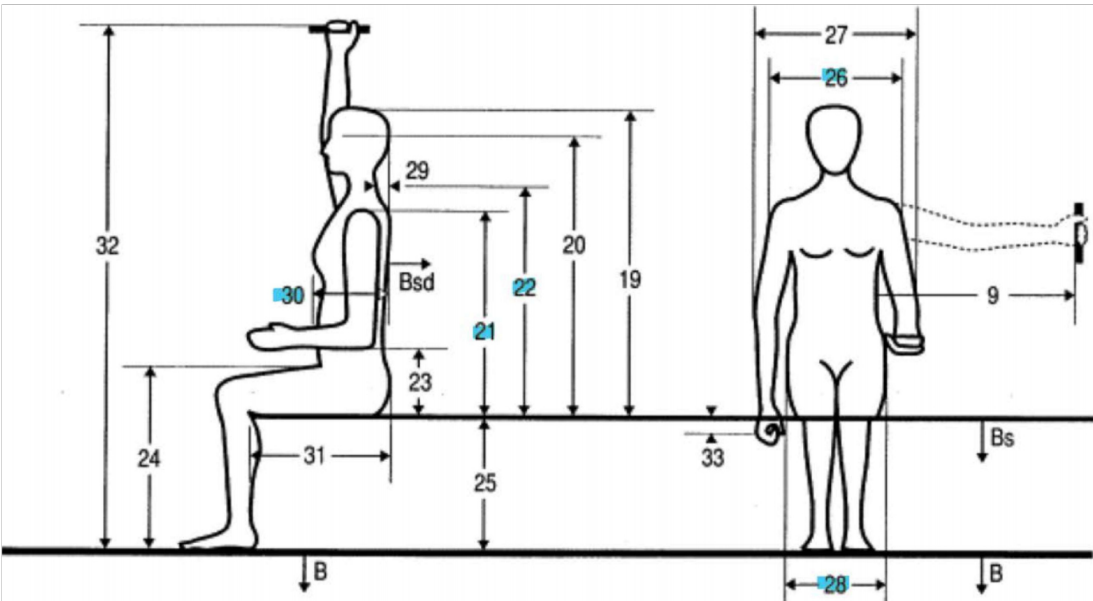


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PROBLEM DEFINITION \*\*

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

As stated in the introduction section, current backpacks on the market are designed for a wide percentile of the public. Some levels of discomfort are always present after long duration uses as it is dependent on the user's environment, posture, and use-case scenario. Therefore, this project investigates prolonging the absence of discomfort for athletes by providing knowledge to make new backpacks and improving aspects of current models. Potential challenges can also include the balance of a high-quality product for low manufacturing cost, having a product that can easily break into the market, and/or should fit a large range of users i.e., a backpack that fits all women.

It is important to focus on the target group to collect data and determine factors that are of issue and how they can be enhanced. In addition, maintaining user expectations on how they perceived the product versus the level of 'comfort' it provides. Reasons being measuring comfort can be subjective and nonquantitative. The scope of this project can be divided into two parts: One, to research and analyse gender differences in terms of upper anthropometrics to use as guidelines for backpack design. Two, generate concepts, features, and prototypes to improve the fitting and usability of the backpack for the selected sports.

ASSIGNMENT \*\*

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... . In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Develop an optimized backpack specifically for women that ensures fit and absense of discomfort that is suitable for fast-hiking

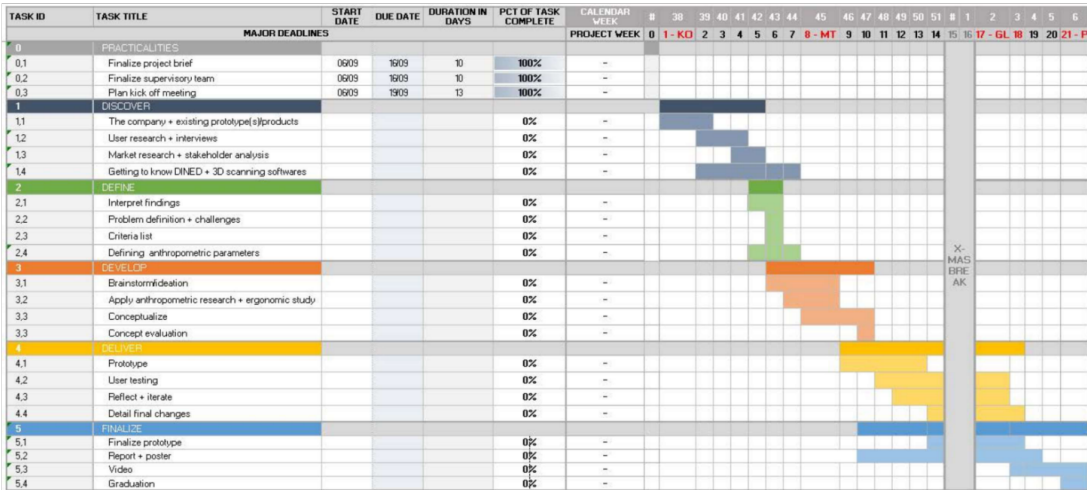
The scope of the graduation project is divided into two parts to achieve the specified goals. The first part of the project with include extensive research and analysis regarding the gender differences of upper anthropometry to serve as guidelines for backpack designs. Usage of the CAESAR/DINED system and (dynamic) 3D scanning will be used in the research/exploration phase. In addition, gathering feedback from target group to determine the issues and challenges to create a more fitting backpack. Market research will be conducted as well. With that and communication with the client it will deliver a list of requirements that can be carried into the next phase.

The second part of the project involves ideation and iterative prototyping. This includes the improvement of various features for the backpack whether it is the shoulder strap or front clip. This will be tested and validated with those that matches the proposed target group. As an end-result, I aim to deliver a compiled research analysis of relevant female anthropometric parameters as guidelines for backpack design and prototype of the backpack with improved concepts/features as inspiration for the client

PLANNING AND APPROACH \*\*

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 23 - 9 - 2022 10 - 2 - 2023 end date



The planning of this project reflects the Double Diamond process where it will be split into the four phases (Discover, Define, Develop, and Delivery) and an additional phase (Finalize) which includes preparation of the final report, poster, video, and presentation.

My aim is to dedicate 4 days of the week to this project and 1 day for an elective course. Although, this might change the second quarter.





Personal Project Brief - IDE Master Graduation

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... . Stick to no more than five ambitions.

Stepping into my last semester, I wanted to work on a graduation project with a company to gather knowledge about the working culture. In addition to being able to create a tangible product as an end-result that will best showcase my design knowledge. After my AED project of working on the development of a video gaming controller for boys with Duchenne's, I wanted to explore the realms of ergonomics and comfort when it comes to designing consumer products. Therefore, this project fits within the vision I had to challenge myself outside of my comfort zone to determine a specific field of interest in design.

Competencies I want to improve

- I want to explore working and prototyping with various textiles when it comes to designing wearables.
- Anthropometric. To research, analyse, and use anthropometry in design, including 3D scanning technologies.
- To create a tangible product for the specified target group as it comes to dynamic ergonomics and comfort that can improve their selected activities.
- Planning. As it is an individual led project, I hope to make mistakes I can learn from in terms of project management and development from an organizational standpoint.
- To gain knowledge on what its like to work with textiles, fabrics, wearables, sports design & innovation. Additionally, to form connections.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30Page 7 of 7

Initials & NameNKLuuStudent number5430038

Title of ProjectDesign an optimized backpack for women

B PRODUCTS ON MARKET

Table B.1: Evaluation of products on market matrix

		Gregory Jade 28L	Osprey Tempest 20L	REI Co-Op Trail 25L	Gregory Juno 24L	Osprey Ultralight	Sea to Summit Ultra Sil	Osprey Sirrus 24L	CamelBak Sequoia 24L	Gregory Maya 16L	Deuter Speed Lite 22L	REI Co-Op Flash 18L
Comfort	Formed back panel	X	X	X	X			X	X	X	X	
	User back to back panel	X	X	X	X			X	X	X	X	
	Padded hip belt	X	X					X		X		
	Padded shoulder straps	X	X	X	X			X		X		
Versatility	Compression straps	X	X	X	X			X		X	X	
	Hip belt pockets	X	X	X	X			X	X	X		
	Water bottle pockets	X	X	X	X	X		X	X	X	X	
	Rain cover	X		X					X	X		
	External loops	X	X	X	X	X	X	X	X	X	X	X
Ease of Use	Adjustable torso	X						X		X		
	Backpack opening	U-zip	U-zip	U-zip	U-zip	U-zip	U-zip	U-zip	U-zip	U-zip	U-zip	Roll top
	# of storage pockets	5	5	5	4	2	1	6	7	8	3	2
Durability	Material	210D Nylon	70D x 100D / 420D Nylon on bottom	Recycled nylon	210D / 420D Nylon on bottom	40D Nylon	30D Nylon	210D / 420D Nylon on bottom	420D Nylon	210D Nylon	210D / 420D Nylon on bottom	Recycled nylon
Weight	Grams	1191	879	850	879	113	85	1219	1021	748	456	255



Figure B.1: Recommended women's daypack on an ease of use and weight scale

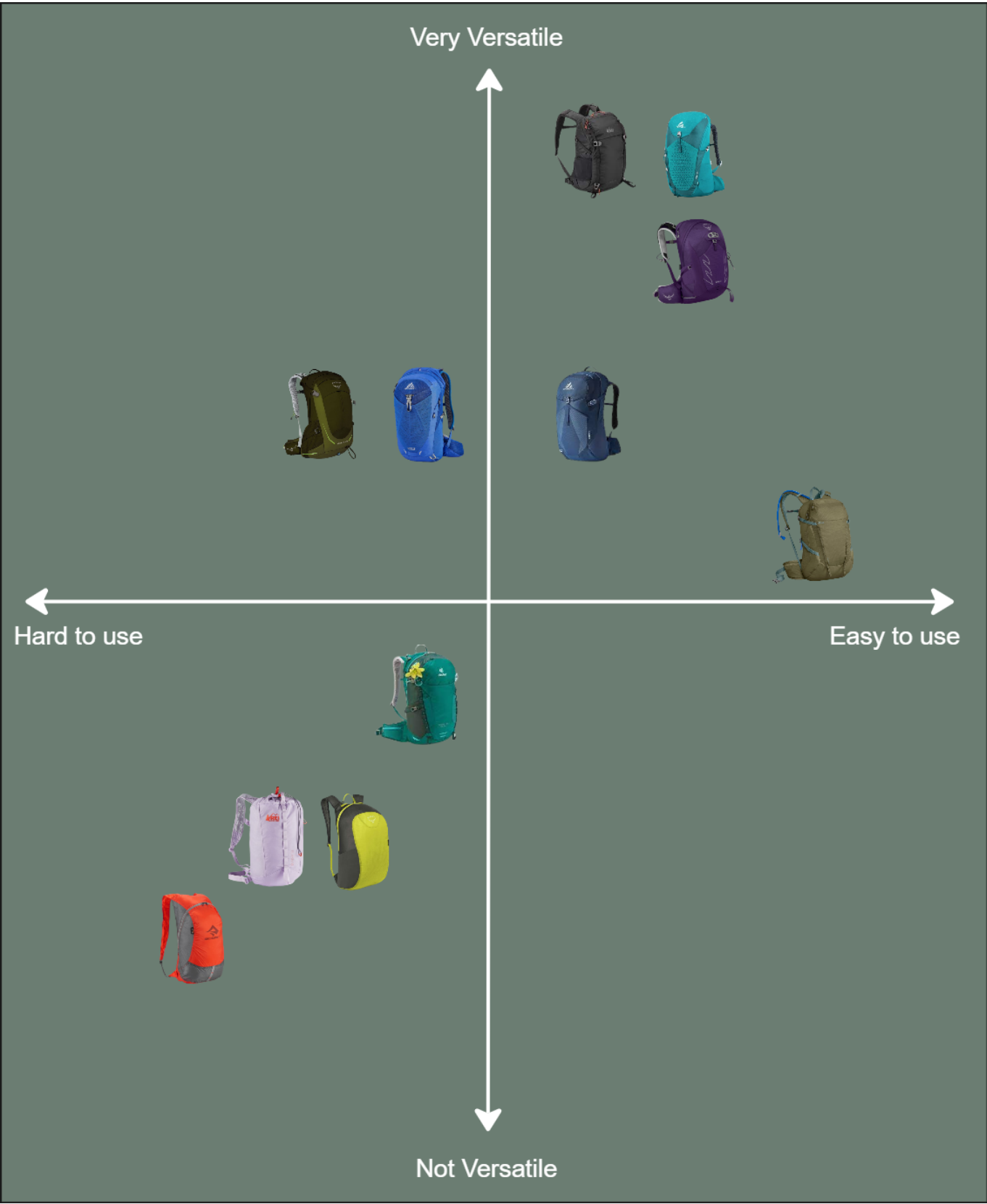
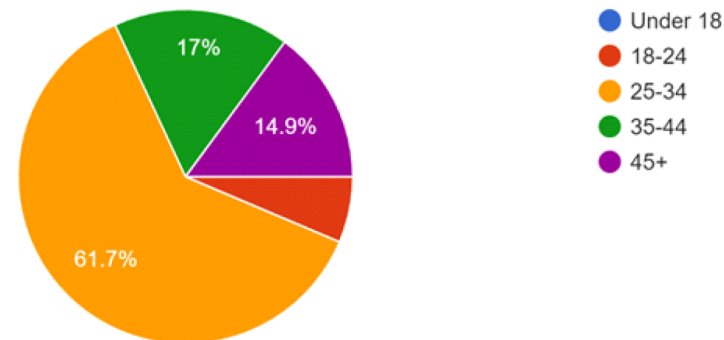


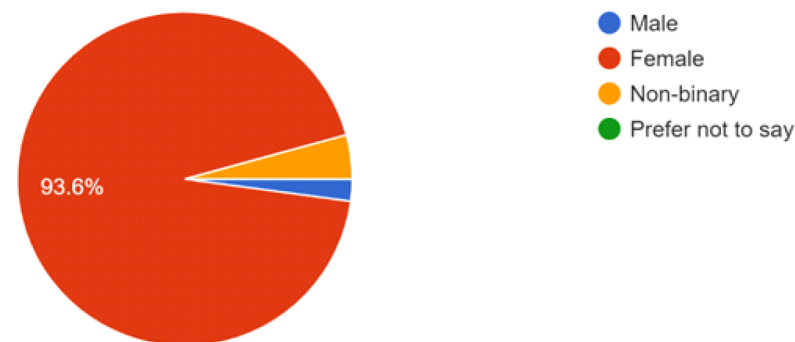
Figure B.2: Relationship between versatility and ease of use. It can be stated that the more versatile the pack, it is harder to use efficiently.

Note: The following survey results are raw, unfiltered data collected from Google form responses. Many answers were filled out by the users which could be repetitive.

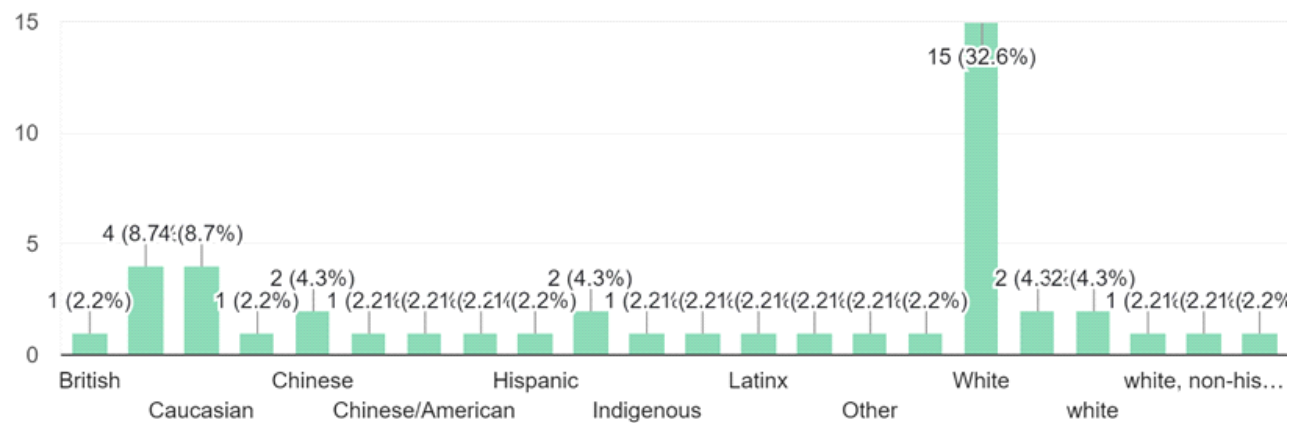
## General Information



47 responses

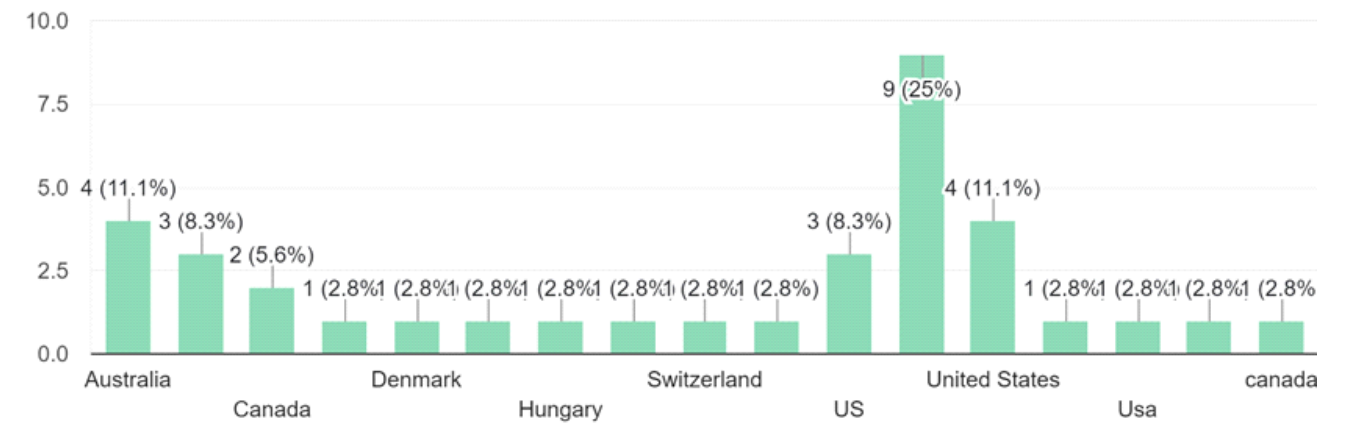


46 responses



What country are you currently residing in?

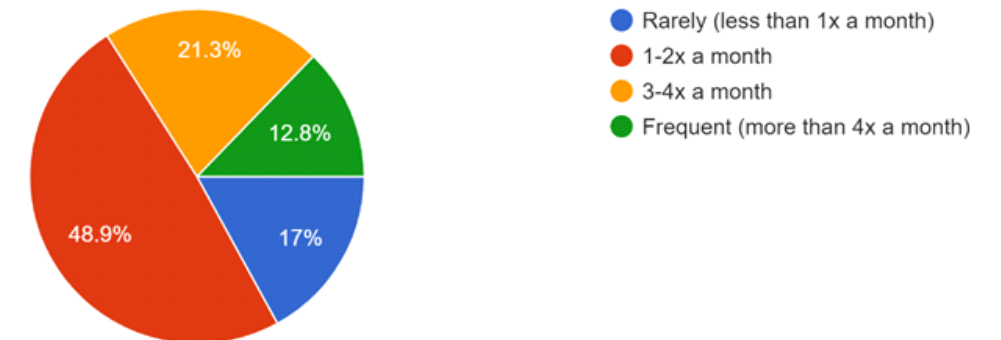
36 responses



## Hiking Background

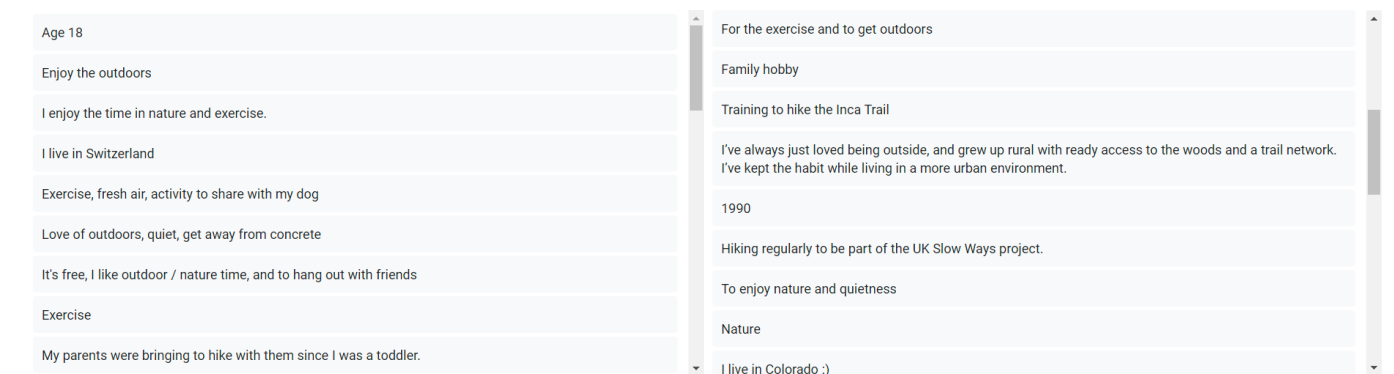
How often do you hike?

47 responses



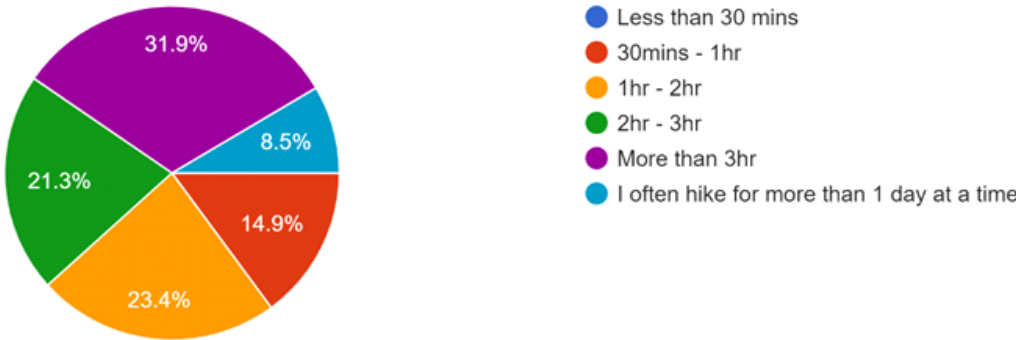
Why did you start hiking?

36 responses

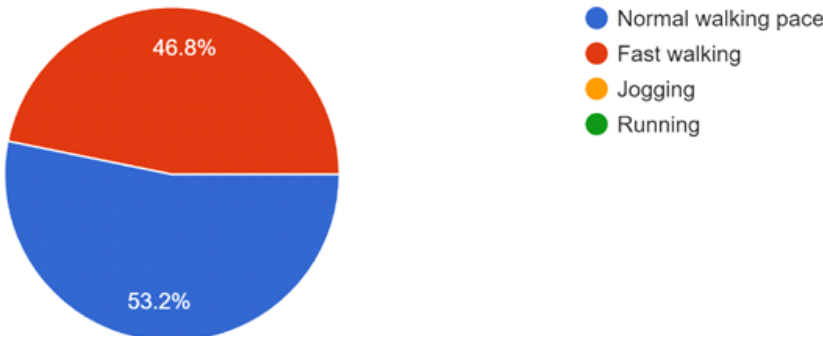


I like nature	I moved to the PNW, where hiking is a popular activity. Wanted to see the sights & get some exercise, and it's a great (and free!) activity to do with new people to make friends
Fitness, being in nature	Scenery, exercise.
For fun	Interest
Enjoyable form of exercise, discover more of my area	For exercise and to reduce anxiety during covid lockdowns
Nature	School trips. I felt like I could finally breathe
Love of nature	Lived in the mountains, needed a way to pass the time
Fun, Heath, travel	Taking in beautiful views while getting in a great workout. What's not to love?
2011	Love being outside and finding new views
I moved to the PNW, where hiking is a popular activity. Wanted to see the sights & get some exercise, and it's a great (and free!) activitv to do with new people to make friends	Pandemic trauma

What would you say on average are the duration of your hikes?  
47 responses

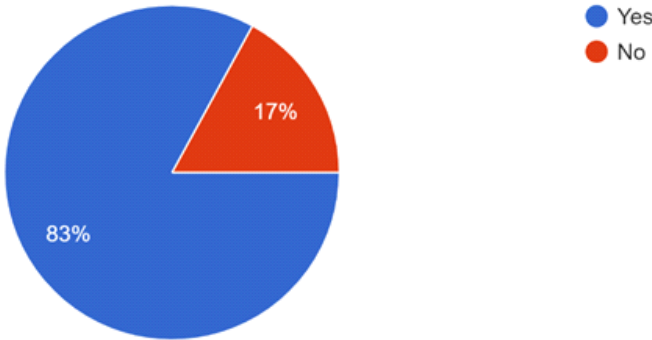


What would you say is the pace of your hikes?  
47 responses

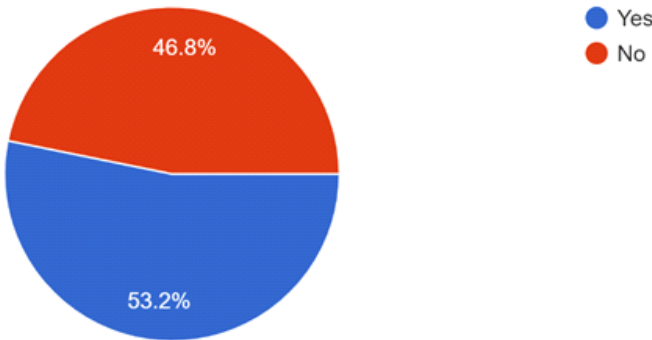


About your Backpack

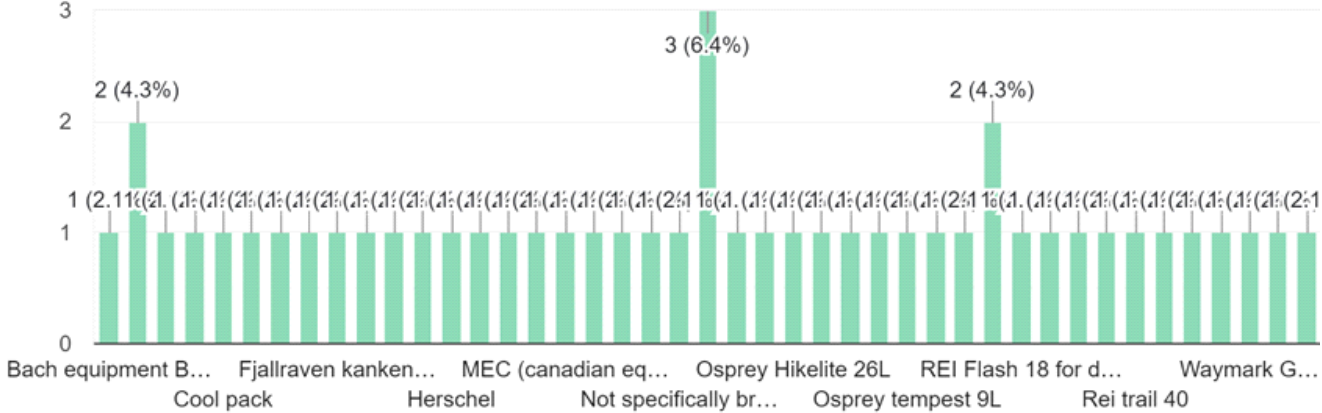
Did you purchase a backpack specifically for hiking?  
47 responses



Do you have multiple hiking backpacks?  
47 responses



What is the brand/model of the backpack you use for day hikes?  
47 responses

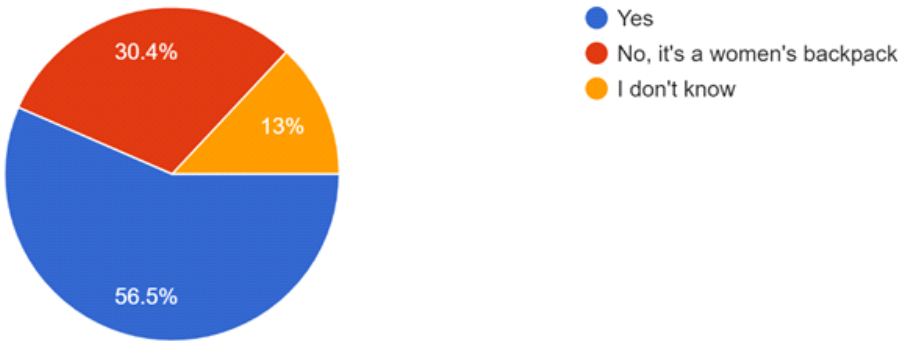




Briefly explain why you chose this brand/model  
47 responses

They come in varying sizes, recycled materials, water/reservoir bag capable, light weight, adaptable, carrying capacity, securing/support straps, comfortable waisted straps (o), internal support frame (o), safety whistle integrated somewhere on backpack.	Good hip belt, light weight, good volume and large stretchy external pockets
Cheap, it has a chest strap to make it lay flatter when full	Comfortable, pockets/storage
I'm used to their brand and have used them before for small day packs	I had it fitted. I needed a small size.
Pocket arrangement, comfortable hip belt	It holds a bladder and has chest and hip clips but is really light and easy to pack to take on vacations
Brand name for durability, fit and features.	Bladder compatible, compact, hip pockets, side pockets, light, love the green colour, within budget, ventilation panel
it was free for a project	Easily obtainable in Australia, high quality, comfortable
has hip strap, could also function as a school backpack with laptop sleeve or as a hiking pack (multi-purpose)	Lightweight, packs down to take it traveling, lots of space
I had an osprey because it was popular. But did not like it at all. Dakine one fits great and lots of straps and	Recommendation
I had an osprey because it was popular. But did not like it at all. Dakine one fits great and lots of straps and pockets. Rei one is larger and has lots of comfort straps and space	Long history of buying
Amazon recommends	Reviews, Size, customization available (s straps), weight, durability
I drink a lot of water and carry little with me while hiking	value for money, good return policy
It was a good price/quality choice	I wanted a very small daypack for hiking, this one was in the lower end of the price range but had a lot of straps/lashing to attach things if I wanted to carry more and a built-in rain cover. I went to REI and tried on all the backpacks I could find in this size range and this one was the most comfortable by far.
Size, weight, comfort	To use my liquids reservoir to stay hydrated without having to stop and pull out a water bottle. Hiking with a dog means one hand is holding a leash.
It is a trustworthy brand in the size I was looking for.	Inexpensive and good quality and size
Small but has a cover, good back ventilation	It was cheap, small and fairly lightweight
Good price to feature tradeoff, good size	Was a hand me down. Got a good harness, light weight, minimal
Old pack boug	It was free, and holds what I need it to for my shorter (4hr-7hr) hikes
It's got good capacity, exterior mesh pocket, has waist belt padding, sternum strap, and looked comfortable.	Inexpensive and good quality and size
I bought it for school and it stayed with me to this day.	It was cheap, small and fairly lightweight
It's smaller, lightweight, simple, has stretchy pockets, and is made in the USA.	Was a hand me down. Got a good harness, light weight, minimal
I liked the materials it was made from. It had two large side pockets for water. The quality was very good. Very versatile with places to attach things on the outside of the pack.	It was free, and holds what I need it to for my shorter (4hr-7hr) hikes
It was cheap and the only yellow bag I could find. Turns out it's actually excellent.	It's not the most functional but it is aesthetic enough to be used in urban environments as well. I often hike on vacation and need the bag to serve double duty
Breathable, light weight, adaptable, hydration sack area, the warranty	Good size, liked the pocket set up and pole attachment capabilities.
Lightweight, roll top, big/open front pocket, nice hip belt and good shoulder straps	Comfortable fit. Holds all of my supplies and a hydration bladder.
Lower capacity than my multi-day pack, also Osprey fits me well.	Comfort, weight
	Its a pretty common brand, lightweight and spacious

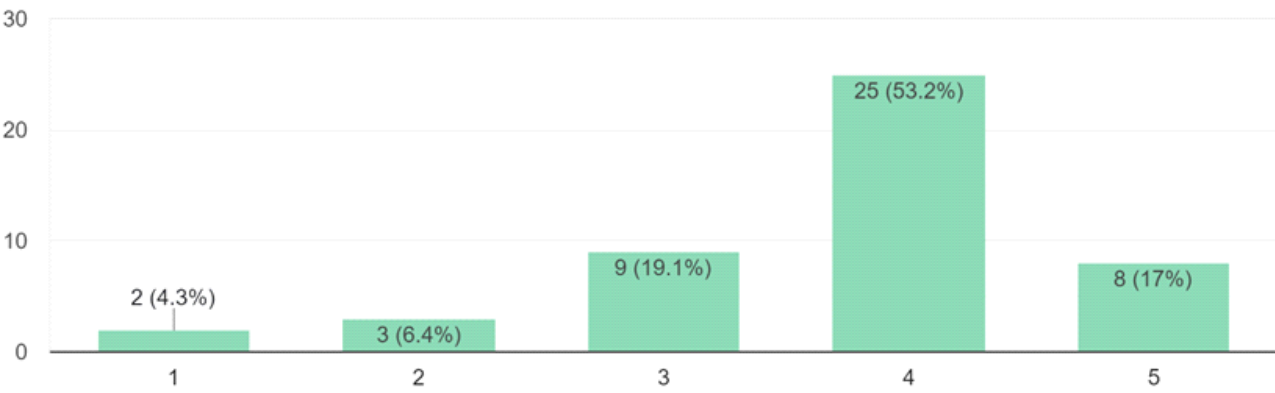
Is your backpack an unisex backpack?  
46 responses



If yes to previous question, is there a specific reason why you chose an unisex backpack instead?  
27 responses

No	No, gender specific was not an option
Cute printed pattern	It was inexpensive and at the time I didn't see any women's specific bags in this size
No reason	No, but since I don't usually carry a heavy load with it I don't think it really matters - for the rare times I do overnight backpacking trips I prefer a women's backpack (Over 60L)
it was provided to me for free	No women's backpacks available in the style I wanted
My partner can use this backpack too.	Nope
Still met all the criteria I needed and has comfortable straps	I don't take much on hikes so didn't feel like I needed the ergonomic benefits of a gender specific backpack
The smaller volume bags were only available in unisex. Also I'm 5'8", so women's bags are often fit optimized for shorter women.	It was free! And the string bag is very small.
I like the brand and the other parts of the bag	I wanted this pack to do a variety of tasks. Day hiking, mountain biking, city walking, travel day bag.
I wanted somethinn small that still had two strans (not a slinn)	Not really
I like the features present in the pack.	
Why would I want a women's backpack? Is it somehow custom made for women? A woman's backpack sounds like an excuse for a pink tax.	
See above	
It had slightly more volume capacity than the women's version, and I needed slightly more room for a backpacking trip.	
No. I tried it in the shop and it fits me.	
No, gender specific was not an option	
It was inexpensive and at the time I didn't see any women's specific bags in this size	
No, but since I don't usually carry a heavy load with it I don't think it really matters - for the rare times I do overnight backpacking trips I prefer a women's backpack (Over 60L)	

How would you rate the fit of the backpack to your body?  
47 responses



Please explain your answer  
41 responses

The straps can be adjustable to make it comfortable for any clothes type I am wearing. waist straps are padded and comfortable. The padding on the back of the backpack allows for dynamic airflow to keep my back cool and adequate cushioning	Restricted from keeping my neck and head up While mountain biking
It's a backpack. It's not sexy, it gets the job done.	The rope can be changeable.
Adjustable and small enough that it's comfortable to wear for long periods	Buckles for the backpack rest directly on my chest instead of underneath it which can be a bit uncomfortable but it still fits perfectly fine everywhere else
Frame size and ergonomic hip belt	I think I choose either a womens or teens backpack. It was the best choice but still not very comfortable. Kids backpacks were too small.
It fits very well but rubs a little on my front shoulder.	Hip belt is a little long, but everything else fits very well
no problems with it	It fits fine. No issues.
the back feels too broad, when using the waist strap it doesn't feel like the strap puts much weight into my hips (sits instead on my shoulders). for my home-made bag, it's comfortable when not a lot is in it, but when there's a lot of weight it all goes into my shoulders cause there is no waist strap	More 2.5- it's too long for my torso but at 12-15L it doesn't matter as much
	I lift a lot, so have a more muscular upper body. Most women's specific packs/clothes do not account for

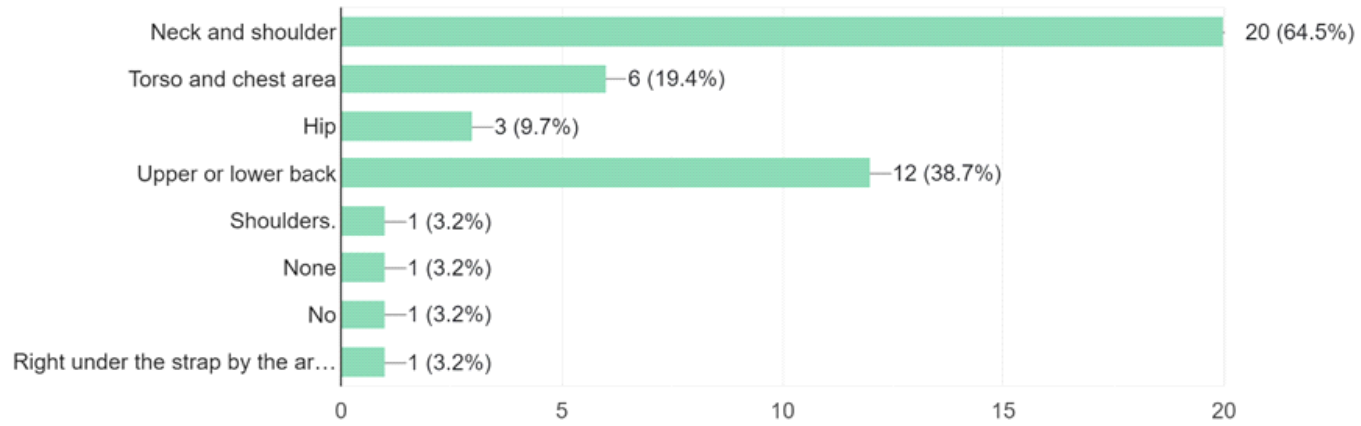


I lift a lot, so have a more muscular upper body. Most women's specific packs/clothes do not account for this, so fit in shoulders/arms could be better	Womens backpack with multiple sizes to fit my smaller frame
Fit's pretty well.	Straps are very thin as it is packable, can fold up sometimes
It is comfortable to wear for many hours.	Chest area not super comfy, even after dialing in the fit. But still fits pretty good.
The straps are comfy and it's a smaller pack so it works well.	as a woman with large hips i find it difficult to get the waist strap to sit properly around my midsection, it rides up
The shoulder straps are very comfortable on my shoulders and the backpack rests nicely in the curve of my back. No pain even when carrying 40 lbs.	It is incredibly comfortable, but the chest strap is very awkward to use given my large breast size.
It doesn't feel overwhelmingly comfortable, but it's not uncomfortable either. It's a little tall for me - the frame goes above my shoulders.	Straps fit my shoulders well, the pack is the right size for my back and has a chest strap and load lifters to adjust the load.
It's the best fitting pack I have, but I feel it leaves a lot to improve upon. When it's fully loaded for a multi-day trip, difficulty sections of the trail begin to get painful.	I usually travel light and in a group so we share loads.
	Hits my tailbone unless I tie up the strings to make it lie better.
Feels good, just a little off for torso length but not too bad	It is incredibly comfortable, but the chest strap is very awkward to use given my large breast size.
Good weight and it doesn't get sweaty.	Straps fit my shoulders well, the pack is the right size for my back and has a chest strap and load lifters to adjust the load.
The "miss fit" is only a slight annoyance, and not truly uncomfortable. The straps feels a bit too long, but if tightened more, the hip belt does not take enough weight. So it slides around a bit.	I usually travel light and in a group so we share loads.
Very adjustable	Hits my tailbone unless I tie up the strings to make it lie better.
It was fitted at REI	Too long and wide
Since it's a small bag it doesn't sit too low on my back and hit my butt. The straps are thin enough that they don't bother my armpits or chest, and the chest strap slides up high enough to be comfortable. Since it's a minimal bag and doesn't have a structured suspension it's not super comfortable when fully loaded and the unpadded straps can dig in when it's heavy.	Its comfortable and the load distribution works for my body
Can't get the hip straps to stay put whilst having shoulder straps comfortable	It has a waist strap so that makes it more adjustable to my frame.
	I have a small waist and most packs need to be completely cinched down to fit
	The model is quite small on the straps and i have a big back so it could be more comfortable

A slightly better fit, increased ability to load my hips with the hip belt. I have not been able to find the sweet spot for my torso with my most comfortable/preferred pack. My other packs are all less comfortable, and I suspect I have a slightly longer torso than what the average "woman's" pack is built for - but I can't get the men's versions to sit in my hips very well.	they are comfy to wear with boobs.
None.	better securing the waist strap in some way so it doesn't ride up
Proper sized back length, proper placement (and perhaps shape) of shoulder straps..	I'm not really sure how to fix the chest strap issue.
None yet	More padding at shoulders
A slight bit of padding in the straps could help	A hip belt, maybe more structure in the back of the pack
No idea	Shorter, wider harness
Thinner shoulder straps, or thinner around the bust only maybe. Vest style straps look comfy, not sure if they are comfy to wear with boobs.	Raising the weight distribution so it sits better on my hips/back, and wider straps.
	Sometimes I struggle with the chest strap because I am short and a women. That's the con to purchasing a unisex pack.
	Changing backpacks actually lol

Have you experienced any discomfort around these areas with your backpack? Select all that applies

31 responses



What do you think can be improved to reduce the level of discomfort?

31 responses

Adjustable/more padding in the straps. Better location of compression straps to adjust back packs compact ability (bring your items closer to you body to keep from moving, bumping around). More internal/external pockets to keep items contained (items sometimes move in back pack and put pressure on places on back)	The metal/aluminum bars in the back are long and uncomfortable and the hip part is not well enough adjustable for me (too wide). It's annoying that the bag is one big tube you can either fill from the bottom or the top and there are no compartments inside the backpack
Having a hip strap to keep the bag in place, or having a longer, skinnier bag that fits my body better	None
Better padded straps	Nothing, it's fine. If it was uncomfortable, I'd focus on reducing weight first.
Hip belt fit is important	If this bag were shorter (40-42cm back length) it would be my dream bag, also if it had women's strap shape. But I already like it a lot, it's my daily driver too.
Padding in the area or a slight curve around the front shoulder.	Slightly wider or adjustable straps and waist belt to account for slight differences in body type
narrower base of the bag (where the hip straps attach), shoulder straps closer in to my body/also narrower	Not sure
Maybe longer the strips.	N/A
Better strap and chest adjustment lengths chest straps underneath breast area or directly above	Nothing

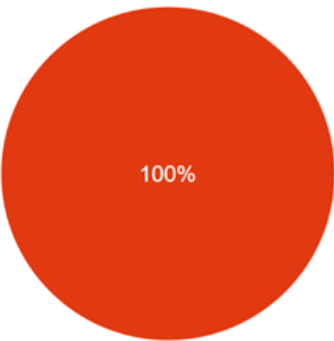
D DISCOMFORT SURVEY

Note: The following survey results are raw, unfiltered data collected from Google form responses. Many answers were filled out by the users which could be repetitive.

General Information

What is your gender?

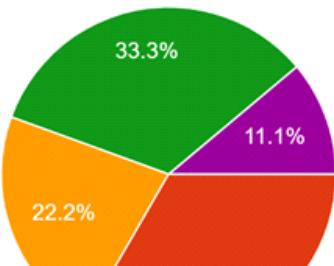
9 responses



- Male
- Female
- Non-binary
- Prefer not to say

How old are you?

9 responses

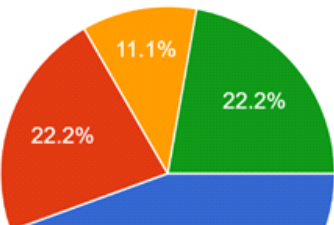


- Under 18
- 18 - 24
- 25 - 34
- 35 - 44
- 45+

Hiking Background

How often do you hike?

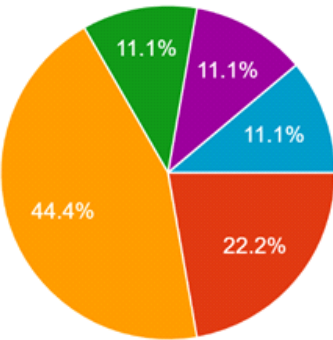
9 responses



- Rarely (less than 1x a month)
- 1-2x a month
- 3-4x a month
- Frequent (more than 4x a month)

On average, how long are your hikes?

9 responses



- Less than 30 mins
- 30mins - 1hr
- 1hr - 2hr
- 2hr - 3hr
- More than 3hr
- I often hike for more than 1 day at a time

Backpack Information

What is the brand/model of the backpack you use for day hikes?

9 responses

Dakine, osprey

North Face Mini Recon

Coolpack mercator

Quechua

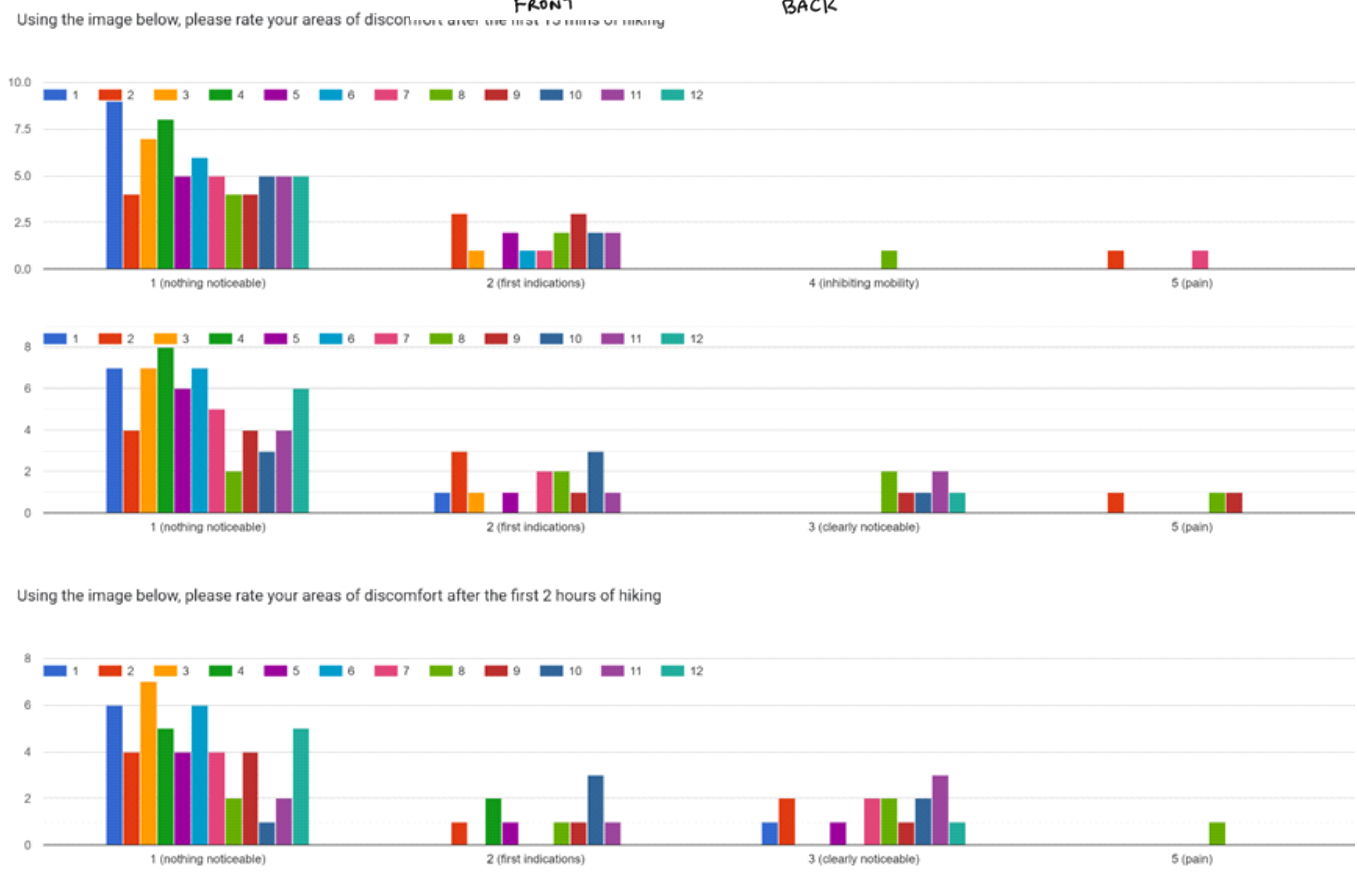
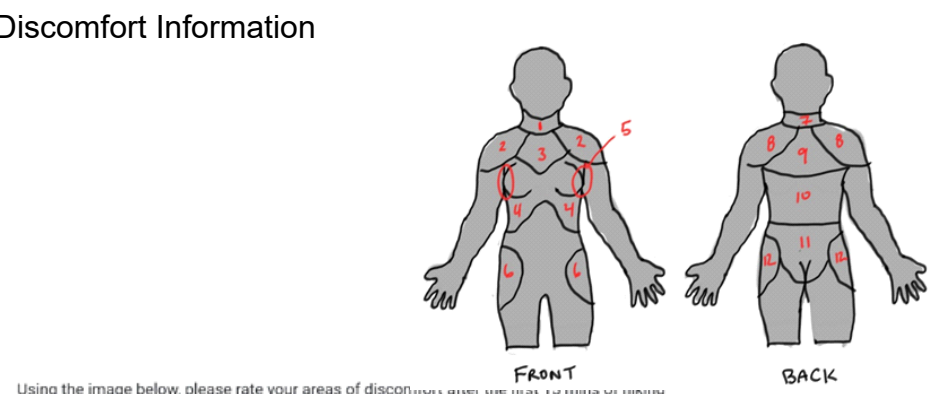
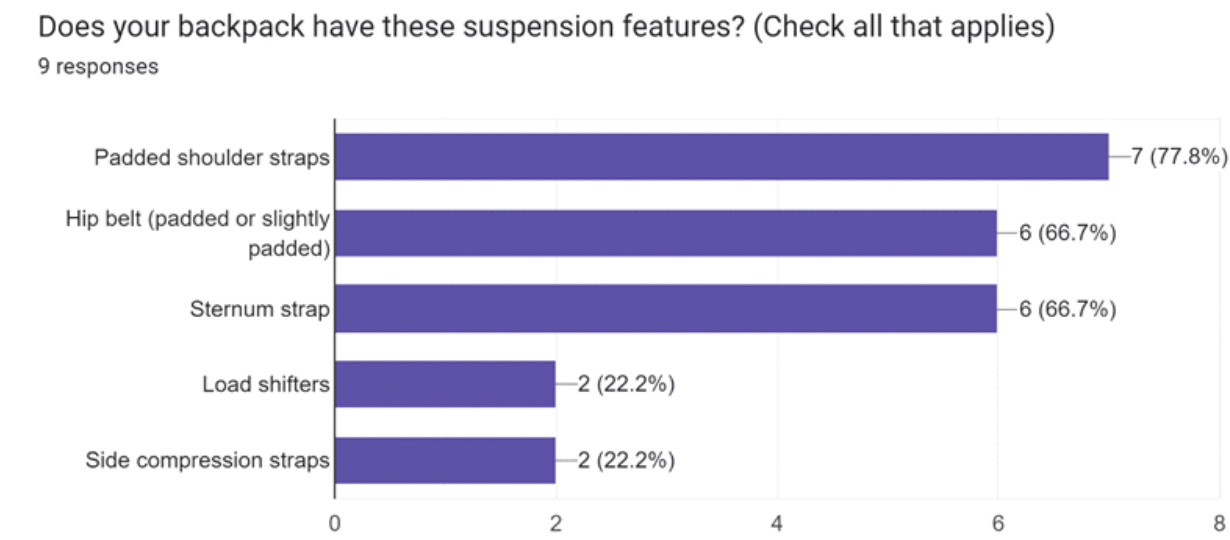
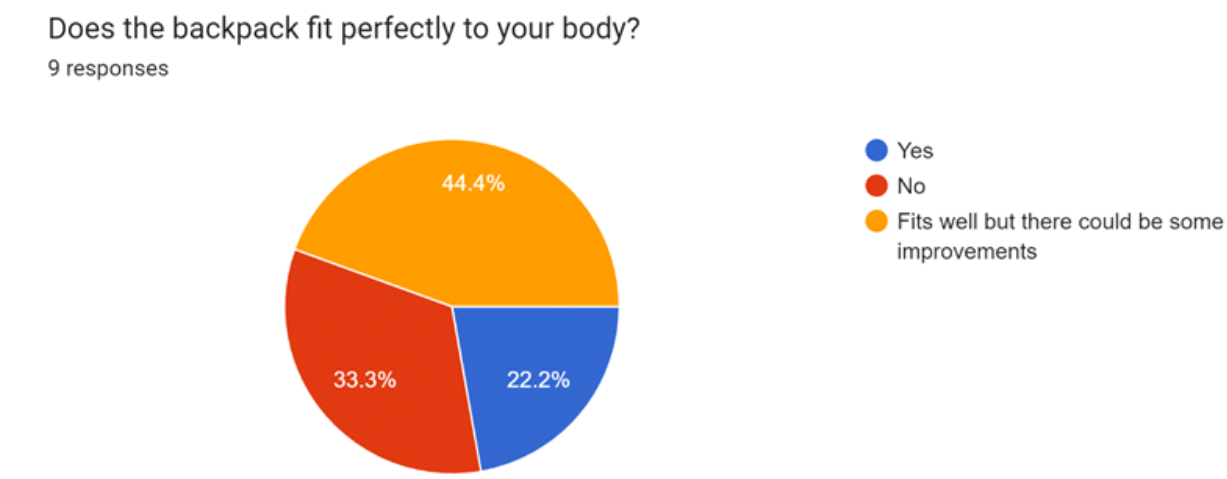
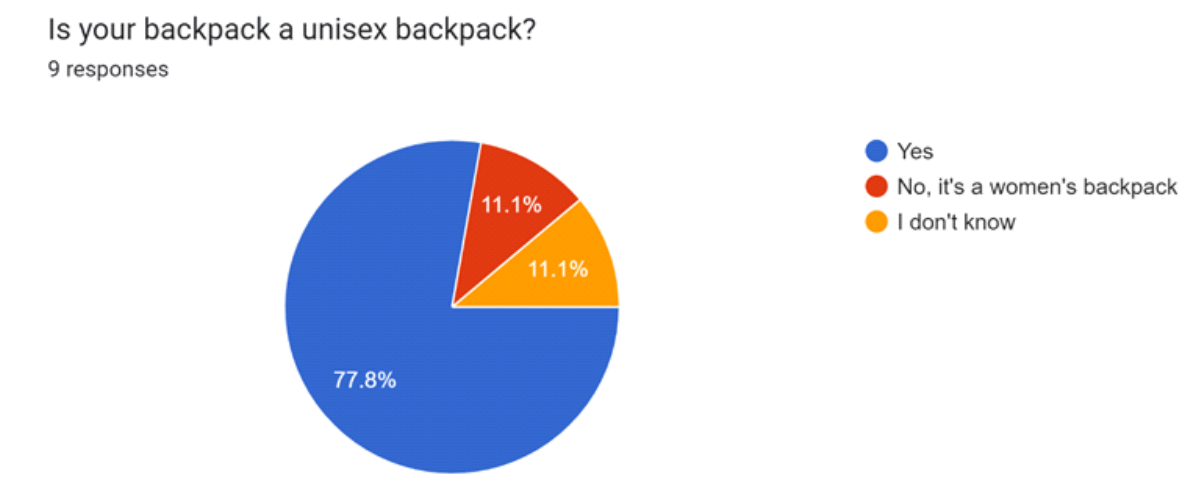
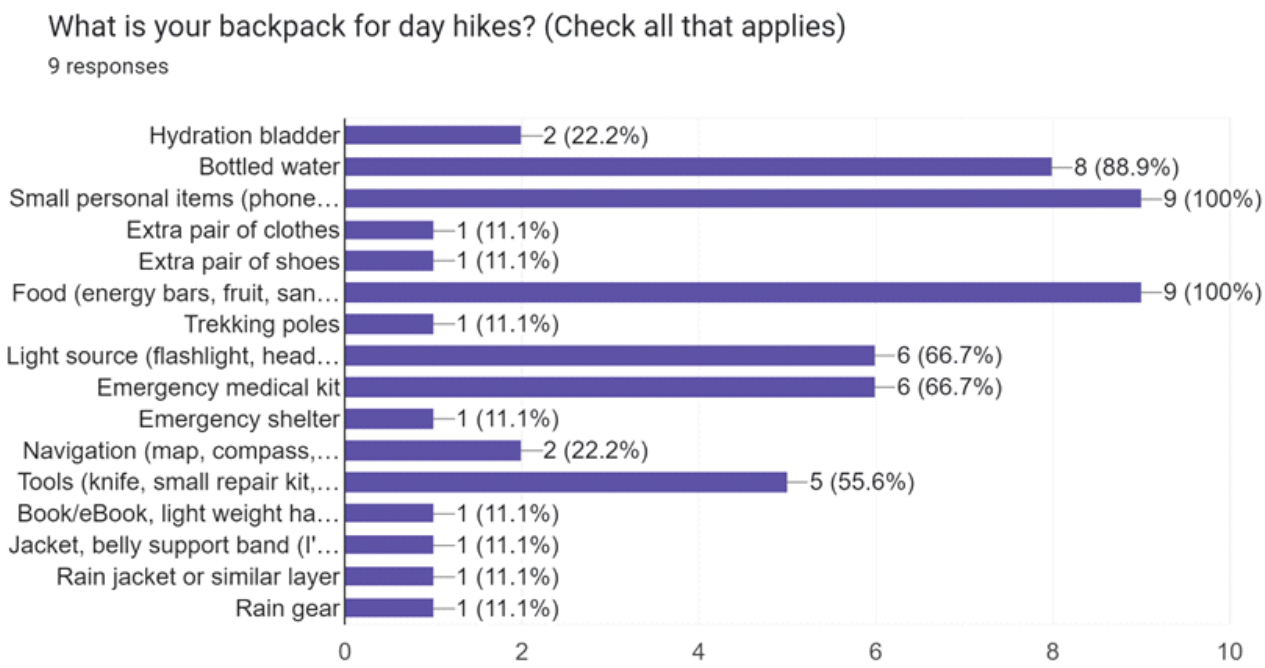
Bach Bicycule

Osprey hikelite 26

Jack Wolfskin

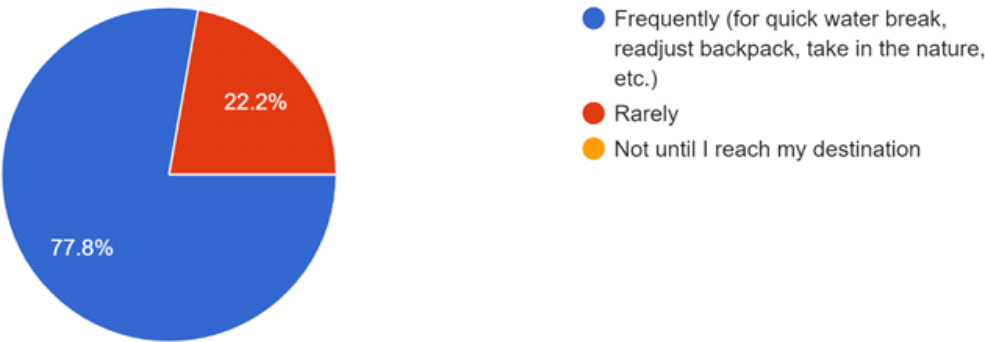
Deuter, Lululemon

Keen daybag, Basil convertible backpack pannier





How often do you stop during your hike?  
9 responses

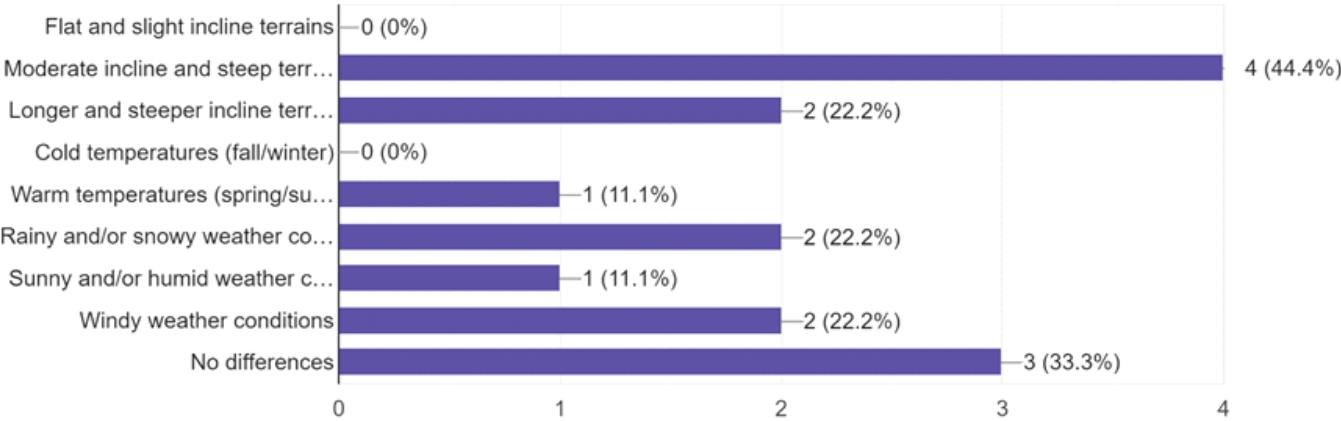


Is there a difference in discomfort you experience depending on the clothing you're wearing (i.e., more padding with more layers, etc.)? If so, please explain why?

9 responses

- No
- Some clothing is thin and stretchy or smooth/slippy and allows the backpack to slide around or pinch more. Can sometimes cause more chaffing/rubbing from the slipping. Or sometimes I fasten my straps more to account for the extra slipping and end up putting more pressure on certain area.
- Not really. Straps are too short to fit over any thick clothes
- Chafing if the straps are on bare skin
- With padding I notice the bag length less

In which conditions is the feeling of discomfort the strongest? (Check all that applies)  
9 responses



DISCOMFORT SURVEY

**Method:** Due to the sporadic nature of hiking and accessibility, it is difficult to organize user testing regarding perceived discomfort of their daypacks. Additionally, the Netherlands is not an ideal location for quick access of trails without the need for long distance travelling. Therefore, a survey was organized to gather participant's recent outdoor experience, their interaction with their backpacks, and the influence of the environment. Participants were asked to recall their journey at various time intervals (15 mins, 1 hour, and 2 hours) and rate the level of discomfort on a scale from 1 (nothing noticeable) to 5 (pain) in 12 body areas. Results can be found in appendix FIXME.

**Results:** Data collected were from nine participants, all women within the 18-44 age range with some exceptions of 45+ who are hiking enthusiasts. Of the nine daypacks stated, seven can be classified as hiking level backpacks as opposed to an everyday, commuters backpack. To relate the level of discomfort to backpack features, participants were asked to disclose the backpack's suspension features to be able to draw conclusion on why users might be experiencing this discomfort.

Figure B.1 shows the 12 body areas, mainly in the upper body, participants were asked to rate on a scale from 1-5 based on the specified time intervals.

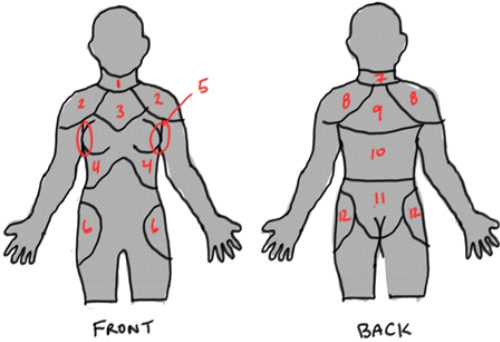


Figure D.1: Body pain area chart

It can be found that the overall rating of discomfort was at max, a three (clearly noticeable) apart from three participants who rated some areas at a four (inhibiting mobility) and five (painful) within the first hour of hiking. The high rating of discomfort can be related to the backpack's suspension features where those without a hip belt experienced higher shoulder and neck discomfort than others.

When asked to account for clothing, participants states that their daypacks can be limiting in adjustability for thicker clothes, but higher absence of discomfort can also be found with thicker clothing. Additionally, some participants mentioned that with the mismatch in material interaction of clothing and the backpack causes chafing, pinch, and slippage which adds to the overall discomfort. Some participants voiced there is no difference when weather or terrain conditions are considered while others experience greater backpack discomfort in incline and steeper terrains and wet weather conditions.

**Discussion:** Overall, it is important to note that some participants did not complete the discomfort rating fully therefore, results are not a full representation of the nine participants. Rating of discomfort is subjective and there are other variables that affect one's rating. For example, one who frequently hikes have established a greater duration of interaction with the backpack therefore, high levels of discomfort are unlikely to occur. Or the feeling of discomfort is high in the initial stages and becomes less noticeable after longer periods of time.

**Insights**  
Trail terrains play a role in the level of perceived (dis)comfort where steeper terrains increase the chances of early on discomfort

Additional clothing is worn to fill in for the inadequate padding of backpacks

DINED Dutch Students, Female, Ages 17 - 27

Table E.1: P1 - P99 body measurements of DINED Dutch students

	Age	Body Mass	Stature	Shoulder B	Shoulder H	Hip B	Hip H	Iliac Crest H	Torso L	Chest D	Chest C	Waist C (OM)	Hip C	BMI
P1	17	53	1603	388	1360	343	960	359	213	827	649	688	889	19
P5	17	53	1603	388	1360	343	960	359	213	827	649	688	889	19
P50	19	64	1698	418	1469	382	1000	468	242	906	722	765	982	22
P95	24	80	1804	452	1570	434	1052	536	277	996	821	870	1117	27
P99	25	90	1829	473	1596	454	1068	597	293	1104	883	936	1162	30
STD	2,09	8,76	62,47	21,38	61,76	27,02	28,44	51,44	28,25	58,17	56,59	59,99	103,24	2,72

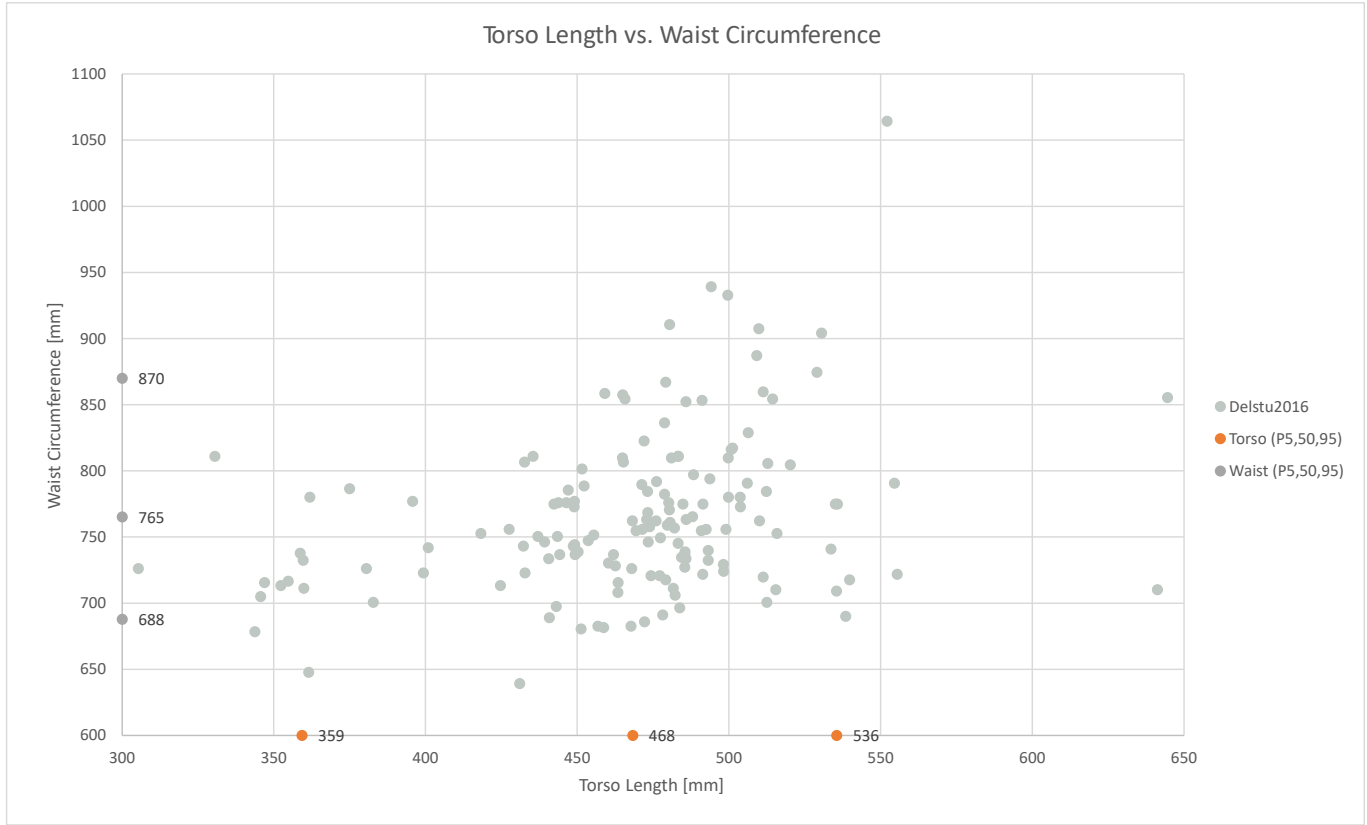


Figure E.1: Sizing chart based on DINED data

Table E.2: Backpack dimensions based on DINED data

	0 - HEIGHT	1 - SHOULDER HIP LENGTH	2 - BACKPACK BOTTOM WIDTH	3 - SHOULDER STRAP LENGTH	4 - SHOULDER STRAP DISTANCE	5 - STERNUM STRAP LENGTH	6 - HIP BELT LENGTH
	Stature	Torso length	Hip breadth	Chest depth	Shoulder breadth	Chest circumference	Waist circumference
P5	1603	359	343	213	388	827	688
P50	1698	468	382	242	418	906	765
P95	1804	536	434	277	452	996	807

ANSUR II Army Personnel, Female, Ages 18 - 45

Table E.3: P1 - P99 body measurements of ANSUR II army personnel

	Age	Body Mass	Stature	Shoulder B	Shoulder H	Hip B	Hip H	Iliac Crest H	Torso L	Chest D	Chest C	Waist C (OM)	Hip C	BMI
P1	18	48	1524	392	1282	334	758	902	367	190	786	668	870	18
P5	19	52	1549	407	1309	349	780	924	386	205	825	712	903	20
P50	28	67	1645	451	1399	399	848	999	426	247	946	860	1022	25
P95	42	85	1753	500	1499	455	919	1080	470	295	1093	1035	1155	31
P99	45	95	1814	521	1533	485	953	1114	493	319	1158	1113	1207	34
STD	7,34	10,18	67,63	28,28	56,47	32,17	42,75	47,45	26,01	26,94	81,23	98,60	74,66	3,28

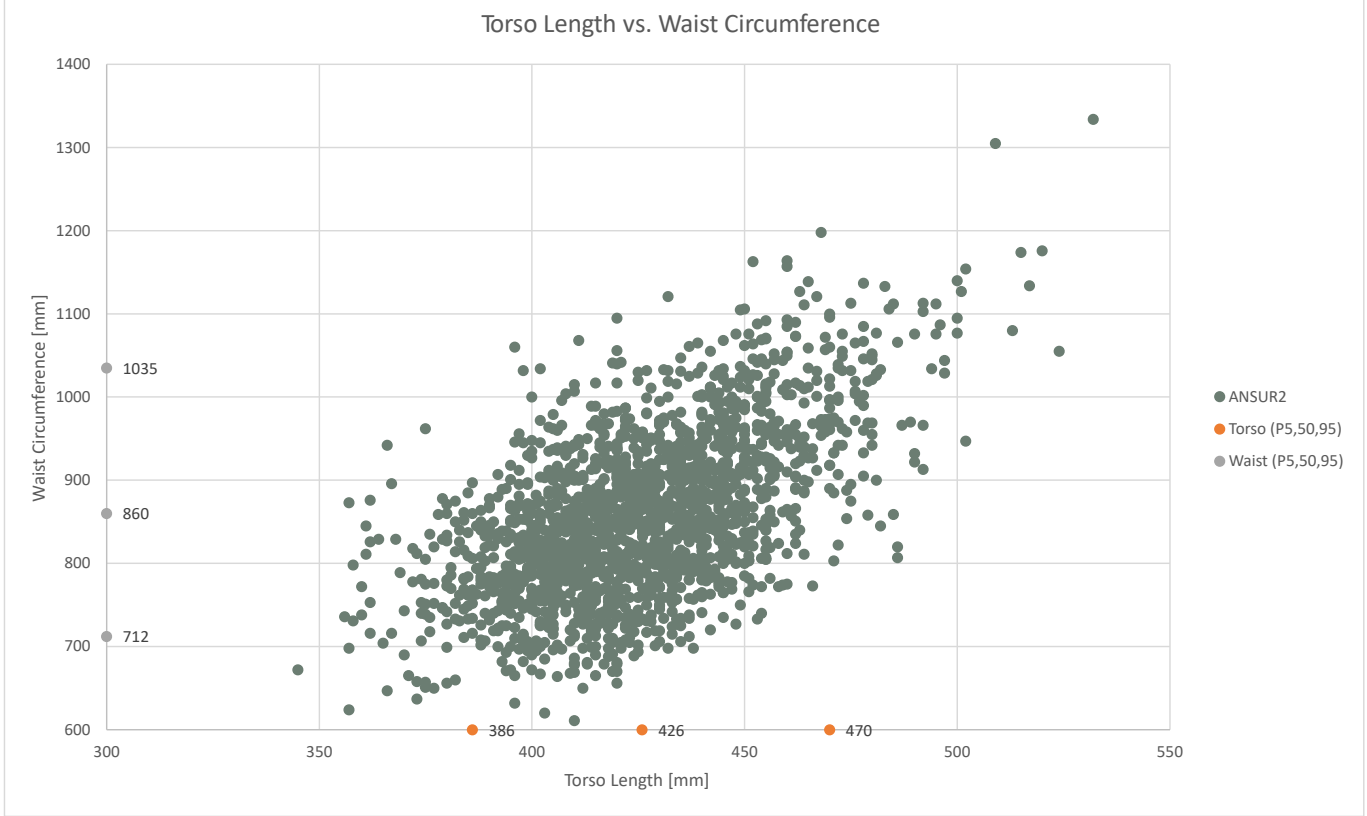


Figure E.2: Sizing chart based on ANSUR II data

Table E.4: Backpack dimensions based on ANSUR II data

	0 - HEIGHT	1 - SHOULDER HIP LENGTH	2 - BACKPACK BOTTOM WIDTH	3 - SHOULDER STRAP LENGTH	4 - SHOULDER STRAP DISTANCE	5 - STERNUM STRAP LENGTH	6 - HIP BELT LENGTH
	Stature	Torso length	Hip breadth	Chest depth	Shoulder breadth	Chest circumference	Waist circumference
P5	1549	312	349	825	336	825	712
P50	1645	354	399	946	366	946	860
P95	1753	400	455	1093	396	1093	1035



Combined Data (smallest and largest)

Table E.5: P1 - P99 body measurements of DINED and ANSUR II

	Age	Body Mass	Stature	Shoulder B	Shoulder H	Hip B	Iliac Crest H	Torso L	Chest D	Chest C	Hip C	BMI	
P5	17	52	1549	388	1309	343	924	359	205	825	688	889	19
P50	24	65	1672	434	1434	391	999	447	244	926	813	1002	23
P95	42	85	1804	500	1570	455	1080	536	295	1093	1035	1155	31
Cover age	25,00	32,65	254,20	112,40	261,00	112,00	156,00	176,27	90,00	268,00	347,27	265,80	11,97

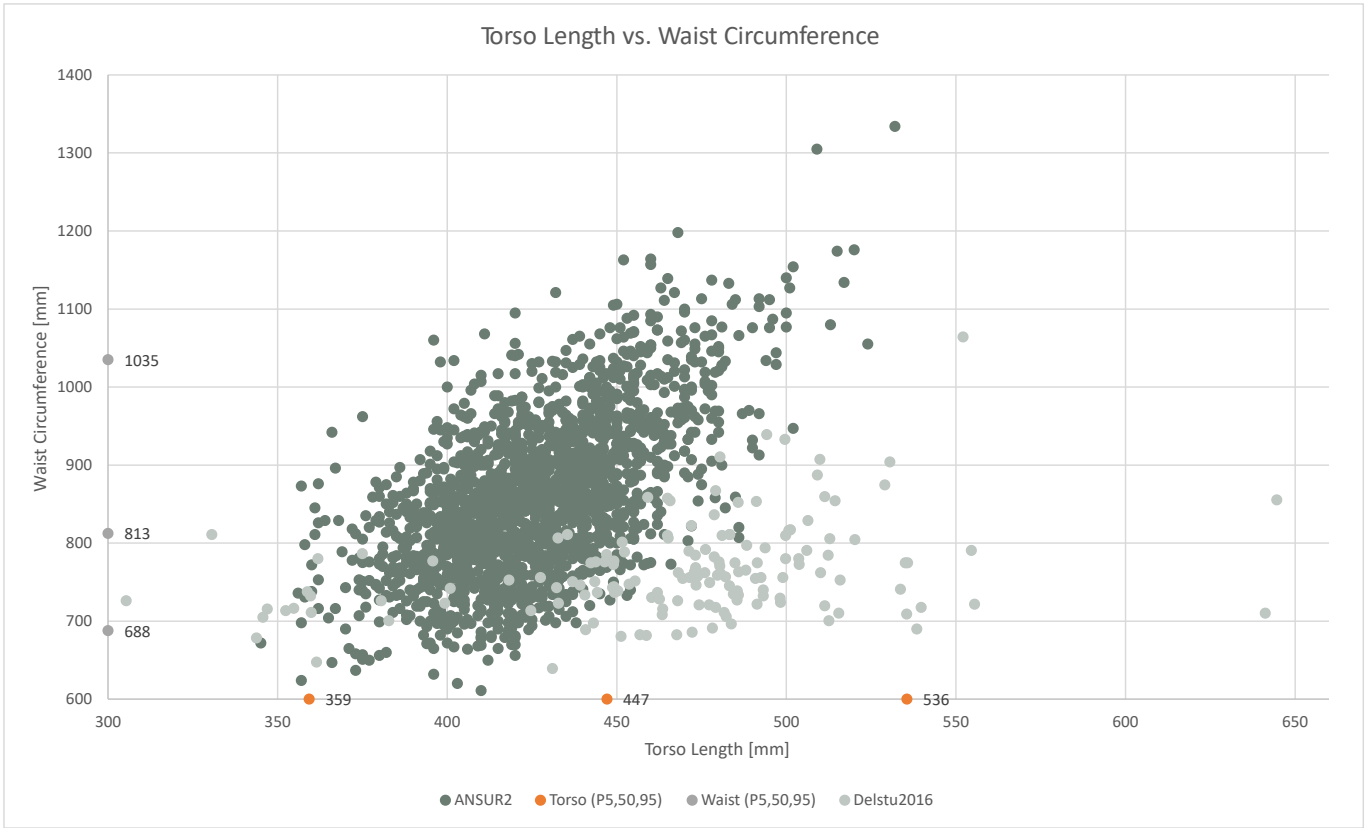


Figure E.3: Sizing chart based on ANSUR II and DINED data

Table E.6: Backpack dimensions based on ANSUR II and DINED data

	0 - HEIGHT	1 - SHOULDER HIP LENGTH	2 - BACKPACK BOTTOM WIDTH	3 - SHOULDER STRAP LENGTH	4 - SHOULDER STRAP DISTANCE	5 - STERNUM STRAP LENGTH	6 - HIP BELT LENGTH
	Stature	Torso length	Hip breadth	Chest depth	Shoulder breadth	Chest circumference	Waist circumference
P5	1549	359	343	205	336	825	688
P50	1672	447	391	244	392	926	813
P95	1804	536	455	295	452	1093	1035
Range	254	176	112	90	116	268	347

[illegible]

How-To 1	Tote bag	Fanny pack	Wheels (trolley/suitcase)	Duffel bag	Straps	External (friend/animal/car/ bike)	Crane	Hands	Boxes	Shoulder slings
How-To 2	Baby sling/wrap	Swaddle soft textile	Velcro	Magnets	Zippers	Latex	Glue	Counterweight	Clips	Inflatable wrap
How-To 3	Modularity	Elastic components	Multiple sizes							
How-To 4	Memory foam	Fan	Heat exchanger, ice cubes	Springs	Rigid frame	Ribbed backing	Back corrector	Mold (custom tight fit)	Anti-gravity system	
How-To 5	Modular parts (straps)	High adjustability	Velcro adjust	2 parts - custom back, standard front	Body mold	Online recommended tool based on body measurements	Multiple styles	Multiple sizes	Exclusion of target group	
How-To 6	Less materials	Less versatility	Polyester vs nylon	Recycled materials	Bare minimum					

Fit, Comfort, and Mobility Assessment

Objective

To test and validate prototype two and collect insights regarding the fit, perceived (dis)comfort, and level of mobility. As well as, identifying points of improvements on the design of a woman optimized fast hiking backpack.

Participant Requirements

Participants that are selected based on the following criteria,

- Identifies as a woman between the ages of 18-45
- Must not have any pre-existing/existing injuries in the upper and lower body that would limit any forms of mobility
- (Fast) hiking experience is not required but preferred

Assessment

Step 0: Introduction

In this test, participants are asked about first impressions (before and after) trying on the prototype, execute a variety of poses and motions that is relevant to fast-hiking, and asked a series of questions along the way regarding fit and comfort. In addition to fit, body measurements will need to be taken. A consent form will be given before proceeding.

Step 1: Taking participant's body measurements

Body measurements are collected from participants (with their consent) as shown below. The data collected allows for comparison of intended versus theoretical fit based on the dimensions of the backpack.

	P1	P2	P3	P4
Height [mm]	1600 (P24)	1630 (P39)	1530 (P4)	1630 (P39)
Torso length [mm]	430 (P51)	430 (P51)	400 (P17)	480 (P95)
Chest circumference [mm]	890 (P25)	1003 (P77)	850 (P12)	810 (P5)
Hip circumference [mm]	785 (P25)	950 (P84)	815 (P35)	740 (P13)
Clothing type	Polyester jacket/yoga pants	Hoodie/jeans	Sweater/jeans	Dry-fit t-shirt/sweatpants

Step 2: First impressions

The following questions are asked,

1. (Before) What are your first impressions when looking at the backpack?

P1	Interesting concept (strapless). Like to rolltop opening for rain. Two pockets for water bottles are nice. Adjustable back is nice.
P2	Adjustable torso is nice. Shoulder hooks like it might just fall off (might be unstable. Could hurt front torso.
P3	Looks interesting taking away the straps. Looks like I can fit a lot of stuff.
P4	Very minimalistic but looks more like a backpacking pack with one big open top.

2. Does it look like something that is comfortable to wear? If so, why?

P1	Yes, adequate padding on shoulder. Back could use some padding. Hip belt should have a little more padding.
P2	Looks comfortable but doubting the shoulder hooks.
P3	Yes, but could have some padding on the back. Shoulder and hip has light padding which is nice.
P4	Yes. Back looks stiff though. Hip belt very lightly padded, could be uncomfortable if there's a lot of weight.

3. (After) What is your initial feeling of the backpack? Do you like it? ~4kg (raw weight, clothes, & water bottles)

P1	Yeah, feels light on the shoulders. More on back of hips and lower portion of back. Shoulder straps feel like it would slip off. Right shoulder more than left.
P2	A bit uncomfortable on the collarbone. There's a gap on the back. Hip belt is comfortable. There's no chaffing, less weight. Comfortable sitting on your hips. Straps could be longer.
P3	Slight pressure on the shoulders. Feels a bit big on me. Don't feel much of the weight.
P4	Feels good. Hip belt straps are easy to tighten. Most have one straps that pulls the other way which makes it hard sometimes.

4. What are aspects that jump out immediately?

P1	Freedom in the chest area. Likes to carry weight on hips than shoulder and back. Feels weight on shoulders more with conventional straps. This is nice.
P2	Shoulder hooks applies on collarbones too much.
P3	Because it is a little big, feels like it would slip. Hip belt is nice and tight though.
P4	Hip belt does ride up and carries a lot of the weight. The bag feels like it's falling backwards. Shoulder straps hit sits in the middle of my collarbone, kind of uncomfortable. More softer padding would be nice.

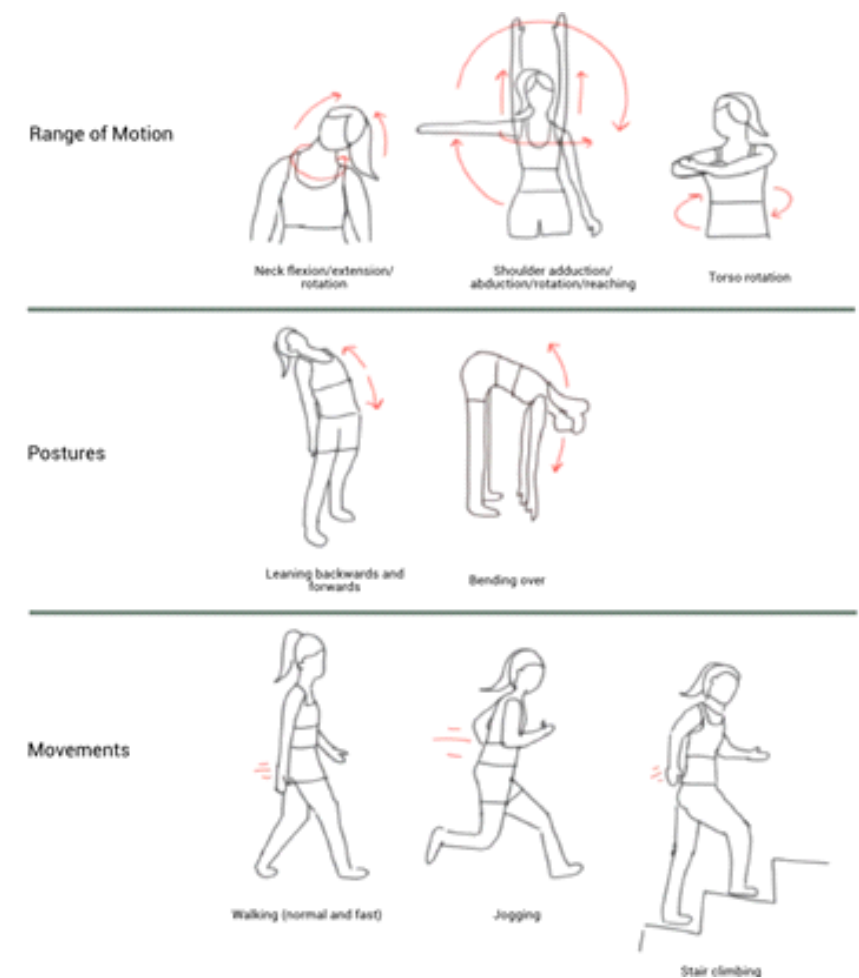
5. (Walk around) Does it feel secured on your body?

P1	Hips, definitely. Correctly aligned with back. There's a gap between me and backpack, should have a formed back. Length is nice. Shoulder straps is secured but feels like it could slip at any moment.
P2	Yes, walking with it is nice
P3	Yes, it sways a bit but it's not an issue
P4	Bag does bounce quite a bit but doesn't fall off. Shoulder straps flexes too much. Maybe stiffer material.

Step 3: Comfort and Mobility

For this part of the study, participants are asked to perform a series of poses and motion with the prototype (~4,5kg in weight). Concurrently, participants will be asked questions about their interaction with the pack.

Upper body range of motion



	<ul style="list-style-type: none"> <li>• Neck flexion and rotation</li> <li>• Shoulder flexion &amp; extension, abduction &amp; adduction (horizontal &amp; vertical), and circumduction</li> <li>• Elbow flexion &amp; extension and swing</li> <li>• Torso rotation</li> <li>• Comments</li> </ul>
P1	Shoulder rotation – straps slips. Needs adjustment. Elbow horizontal adduction/abduction, can feel a push on the ends of the shoulder straps below your collarbones. Collarbone is being used as the hook.
P2	Reaching upwards is a little uncomfortable. It applies pressure to collarbones.
P3	Strap comes off when my shoulder moves too fast. Everything else is ok. Bag could have some structure so it doesn't move around so much.
P4	Both hands reaching was difficult. Bag feels to be slipping from shoulders. Need to readjust.

Poses

- Standing
- Bending over
- Crouching
- Comments

P1	Standing, good. Bending, good but shoulder strap falls off after coming back up. Bending backwards, pressure on collarbones. Crouching, stays secured, good.
P2	Standing, good. Comfortable. Not falling off. Bending over, stick to collarbones. Leaning backwards, fall backwards slightly. Crouching, good.
P3	Standing is good. Bending over, comfortable but some pressure on the collarbones. Leaning backwards, concern that the straps will slip off even though it doesn't. Crouching, good
P4	Standing, good. Bending over, shaky. Crouching, good.

Motion

- Walking (flat and inclined)
- Jumping
- Jogging (flat)
- Running (declined)
- Comments

P1	Walking, good but constantly adjusting straps. Jumping, hip is good, shoulder hook hops with me and gets misaligned. Jogging, suspension can be better. Pack hits small of back. Bag is bouncing. The more jogging, the more misalignment of shoulder straps. Stairs, good similar to walking. Bottom of backpack is droopy.
P2	Walking, sticking to collarbones (rates about a 3). Flexible material (lamp poles that you can change shape.) Jumping, falls off slightly, falls off due to incorrect fit). Jogging falls off slightly when in air. Stairs, good movement, comfortable but might not be for long term.
P3	Walking, good. Jumping/leaping, bag comes off on top. Bottom is very secured. Jogging, it's ok if lightly but I don't think I can run with it.
P4	Walking, nice and easy. Jumping, a little hesitant as pack is bouncy. Jogging, ok but a little unstable. Running, too bouncy.

Questions

1. How does the general shape and size feel to you? Is it "comfortable"?

P1	Good weight on hips (preferred). Freedom of front (top torso). Strap could be wider and longer. Rest is ok. Hip belt should be longer (not straps) because it might chaff with thinner/shorter clothing (jacket ok). Hip belt might ride up with non-form(athletic) fitting clothes.
P2	Shape is ok, size is ok. Has big backpack, size is good for the scenario. Overnight might be nice. Weight is nice in hip belt.
P3	Shape is ok, size is slightly big. Could be more comfortable with some added parts. Could have some frame?
P4	It is comfortable. Back is a little too wide for me. Would be nice to have it form fitting. Shoulder hooks are too flexible to get an accurate fit.

2. How do the shoulder hooks feel to you?



P1	Might be nice to adjust the hooks themselves (width wide).
P2	Pressure collarbones.
P3	Not painful but feels a little awkward having to always move it into place.
P4	Perhaps slightly longer. Feels like it not pulling the pack enough to you. More padding. Widen the gap as it right on my collarbones.

3. How does the hip belt feel to you? How do they wrap around your body?

P1	Feels good. See Q1 comment. I'd would attach the hip belt lower to account for the bag droop.
P2	Same as previous pack.
P3	No problem there. I like to system and shape. Personally, I like more padding and structure.
P4	I like it and the straps! Just be a little cleaner next time and more padding is nice.

4. Do you find this pack to be easily adjustable?

P1	Right now, only hip belt can be adjust while wearing. Torso adjustment needs to take the pack off. Might be inconvenient (possible future design).
P2	Be nicer to move the shoulder hooks around to preference but everything else is easy to use.
P3	Yes, good but could have more slots for torso sizing.
P4	Yes, the Velcro is a nice touch. There needs to be more slots though.

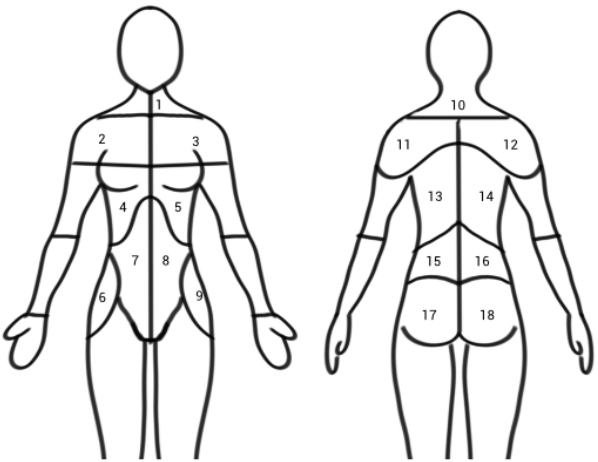
5. Do you find the pack secured and stable when in motion?

P1	Flat, yes. Jumping/leaping/getting air, not as much. Shoulder straps move and becomes misaligned. Hip belt is fine.
P2	Not very stable. Hopping and jogging, moves too much. Mostly bounces too up and down.
P3	Could be more secured to body. Bag feels too big, depth wise which feels like it sags. Walking and stairclimbing is good. Jumping and jogging could be better.
P4	It's ok for walking, standing, and small movements. Too bouncy for large movements. Maybe you need another strap on the under arms to body.

6. Did you experience any discomfort while performing the range of motions, poses, and motion?

P1	Yes, misalignment of shoulder hooks puts pressure on collarbone. Not painful but annoying. Gap between pack and back too large, inconvenience of comfort and leads to more discomfort of the straps.
P2	Yes, collarbones.
P3	Yes, shoulder area
P4	Yes, my collarbones for the extension range of motion. A little hesitant because pack is not as secured to jump and run.

a. If you had to rate the level on a scale from 1(barely noticeable) – 5 (painful), what would the level of discomfort be in that area? Please use chart as reference.



P1	1 – 3 (noticeable and slightly uncomfortable), 13 & 14 – 2 (noticeable), 15 & 16 – 2 (noticeable). Everything else – 1
P2	1 – 3 (could be 4 with more time), everything else – 1
P3	1, 2, 3 – 2, 6 & 9 – 2 (very light padding), 15 & 16 – 2 (no padding)
P4	1 – 2, 2 & 3 – 2, 15 & 16 – 2, everything else – 1

7. Do you feel like you can wear this pack for a longer duration, perhaps 1 hour on the trail?

P1	See Q6a.
P2	Maybe not an hour. If straps change then definitely
P3	Maybe with changes and if pack has some structure for jogging and running
P4	Yes if it's just walking and hill climbing

8. Any other comments

P1	Shoulder – different shape. Flare out end to a triangle/trapezoid shape. Prefers to hook on upper sternum (top of chest). Back needs to be form fitting. Range of motion too short, should have participants try it at different speeds.
P2	Flexible lamp movement for user adjustability. Silicone or plastic material.
P3	Nope.
P4	To separate what is prototype error vs actual



H CONSENT FORM

CONSENT FORM

Video/Audio & Picture

Name: \_\_\_\_\_

The goal of this project is to develop a fast-hiking backpack with optimized features specifically for women. The users have face challenges in discomfort of the neck, shoulder, and chest regions as the current features are designed with men’s body in mind. The purpose of this study is to test and validate the final prototype (prototype 3) and collect insights regarding the fit, perceived (dis)comfort, and level of mobility. As well as, identifying points of improvements on the design of a woman optimized fast hiking backpack in the form of recommendations for the client.

This will take approximately 15 - 20 minutes to complete. The data collected (images, videos, audio, etc.) will only be used for research purposes and will be stored on researcher’s personal computer until the end of the project. As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by keeping the survey completely anonymous therefore, all images containing identifiable information will be blurred and all participants will be referred as Participant #.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions.

\_\_\_\_\_

This authorization grants permission to use your image (still or moving) and/or your spoken words in perpetuity for educational purposes.

By signing this document, you agree:

- 1. To allow the recording of your image and voice (e.g., photographs, audio, or video).
- 2. To distribute your image or recording in any specified medium, be it print or electronic form, which may include sharing to the client, the supervisors, Arjen Jansen and Lyè Goto, and TU Delft repositories
- 3. That there is no reimbursement for the right to take, or to use your photograph or video or recording, now or in the future.

\_\_\_\_\_

RESTRICTION AND LIMITATIONS:

[ ] None

[ ] Yes, please specify:

\_\_\_\_\_  
\_\_\_\_\_

I have read and fully understand the intent and purpose of this document and am signing it without reservation.

Name (please print): \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

\_\_\_\_\_

Fit, Comfort, and Mobility Assessment

Objective

To test and validate the final prototype (prototype 3) and collect insights regarding the fit, perceived (dis)comfort, and level of mobility. As well as, identifying points of improvements on the design of a woman optimized fast hiking backpack in the form of recommendations for the client.

Participant Requirements

Participants that are selected based on the following criteria,

- Identifies as a woman between the ages of 18-45
- Must not have any pre-existing/existing injuries in the upper and lower body that would limit any forms of mobility
- (Fast) hiking experience is not required but preferred

Assessment

Step 0: Introduction

In this test, participants are asked about first impressions (before and after) trying on the prototype, execute a variety of poses and motions that is relevant to fast-hiking, and asked a series of questions along the way regarding fit and comfort. In addition to fit, body measurements will need to be taken. A consent form will be given before proceeding.

Step 1: Taking participant's body measurements

Body measurements are collected from participants (with their consent) as shown below. The data collected allows for comparison of intended versus theoretical fit based on the dimensions of the backpack.

	P1	P2	P3	P4	P5
Height [mm]	1600 (P24)	1680 (P67)	1730 (P88)	1630 (P39)	1530 (P4)
Torso length [mm]	430 (P51)	450 (P75)	460 (P84)	480 (P95)	400 (P17)
Chest circumference [mm]	890 (P25)	960 (P58)	1010 (P80)	810 (P5)	780 (P2)
Hip circumference [mm]	785 (P25)	850 (P49)	945 (P82)	740 (P13)	815 (P35)
Clothing type	Sweater + yoga pants	Sweater + jeans	Sweatshirt + jeans	Sweater + sweatpants	Hoodie + jeans

1. Do you have hiking experience? What is your experience with hiking backpacks? What would you say is a challenge with your backpack?

P1	Yes. Tried on a lot to find a really good one but ended up getting a travel backpack instead. My backpack does not have a lot of internal pockets and if I don't have the hip belt attached, shoulder straps dig into my under arms.
P2	Yes, I've done some backpacking before, not so much anymore. Don't really have big issues with the backpack but after a while, my shoulders and back starts to hurt. It's nicely padded and ventilated though.
P3	Yes, but not recently. I don't have a specific hiking backpack, I use my school backpack for a lot of things. It doesn't have a hip belt so it can get heavy on the shoulders.
P4	Yes, was into it before starting my masters. Generally, 3-4-hour hikes. Backpack varied between a CamelBak (10L) and school backpack – northface something (20L) depending on the trip. I carried light but it was uncomfortable due to the shoulder strap and sweatiness.
P5	Some experience but mostly with school backpacks. I don't have any major issues with it since I don't carry a lot.

Step 2: First impressions

The following questions are asked,

1. (Before) What are your first impressions when looking at the backpack?

P1	Shoulder straps are longer. Looks neater with intended features.
P2	Looks interesting and minimal. Small compared to the backpacks I'm used to.
P3	Very different from a regular backpack. How do you put it on?
P4	Looks smaller than the previous prototype. Bendable shoulder straps look interesting.
P5	Smaller than the previous one. It might fit better this time.

2. Does it look like something that is comfortable to wear?

P1	No at a glance, shoulder hooks look too rigid in an uncomfortable way. Too structured.
P2	Maybe, if there's not a lot of weight. Padding seems thin. Curious about the shoulder hooks.
P3	It feels soft and light so imagine so
P4	Yes, more than the previous one since the back looks more flexible. Padding looks a little light
P5	Yes, padding is little thin but is less bulky.

3. (After) What is your initial feeling of the backpack? Anything jump out immediately?

P1	Gap between my back and the backpack but smaller than previous prototype. Difficult to adjust the bendable hooks while it's on. Better if it's done beforehand.
P2	It's good. Hip belt is comfortable and so is the weight. I do like that I can bend the shoulder hooks to my preference.
P3	Straps on hip belt are a little short. Everything fits ok.
P4	Feels alright. Pack leans backwards a tad. No weight on shoulders, barely feel on hips. It's lower than most backpacks
P5	It's nice, I don't feel any of the weight on my shoulders. Fits around my shoulders. But I can feel the 3D print a bit.

4. On a scale of 1(loose) – 5 (secured), rate how stable the pack feels?

P1	4 – more secured than the previous. Feels like it’s missing in the middle of pack. Hooks are balance, hip is load bearing, should have a strap between the two.
P2	3 – shoulder hooks keeps bending out of shape. Feels like it might slip backwards.
P3	3,4 – bag moves with you, no issues
P4	3 – sways a little, shoulder hooks isn’t fixed
P5	4 – it fits and sits good

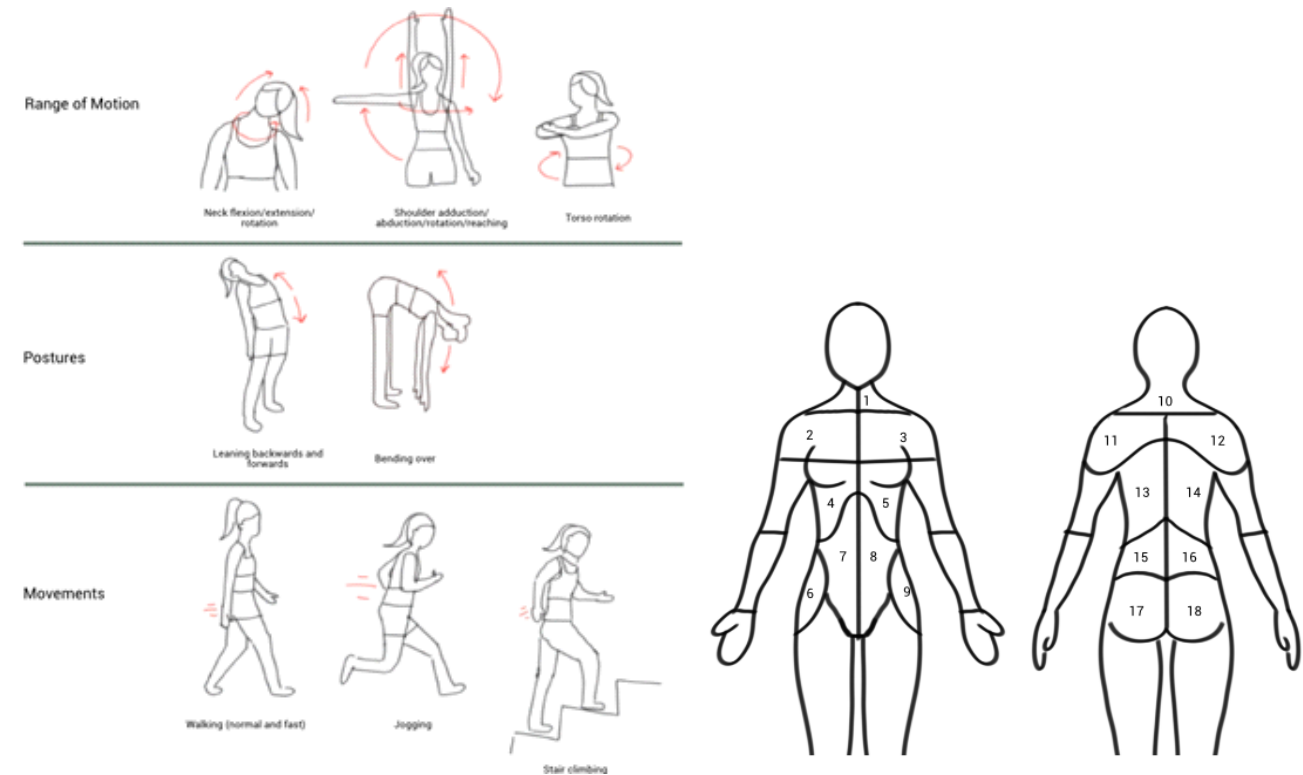
5. On a scale of 1(poor) – 5 (perfect), rate the fit of the backpack. Please justify your answer

P1	3,5 – the gap in the back is annoying and noticeable. Feels uncomfortable, “doesn’t feel correct”. Mentally and physical.
P2	4 – it feels fine. I can move around. If you shape the back then I think it would fit better.
P3	4 – asides from the back gap, it feels fine
P4	4 – should be where it is at
P5	4 – compared to previous, better

Step 3: Comfort and Mobility

For this part of the study, participants are asked to perform a series of poses and motion with the prototype (~4,5kg in weight). Concurrently, participants will be asked questions about their interaction with the pack. In the motion section, participants are asked to jog/run on the flat pavement.

Upper body range of motion



1. (Before) Using the image, please rate (1 – barely noticeable and 5 – painful) your comfort level on the following areas

P1	1, 2, & 3 – 2, 11 & 12 – 2, everything else – 1
P2	Everything – 1
P3	13 & 14 – back gap. Not physical, just mental, everything else - 1
P4	2 & 3 – 2, 17 & 18 – 2, everything else – 1
P5	Everything – 1

2. Range of motion comments

P1	Backpack sways when torso rotates aggressively
P2	It’s good
P3	No problems
P4	Hip belt raises when shoulder rotates
P5	Good, shoulder hooks moves when shoulder rotates

3. Poses comments

P1	No comments, everything is ok.
P2	It’s good, no problems
P3	No problems
P4	No issues
P5	Good

4. Motion comments

P1	Walking – Slight sways of backpack. Off-balance due to gap? Light jog – likes how shoulder straps move with me. Jumping/leaping – same as light jog comment. Stairs – up is good. Down is quite swaying (side to side) rather than up and down. Running/changing direction – based on light jog, very confident
P2	Walking – Good. Light jog – Good, the backpack moves a little. Jumping/leaping – I can feel the backpack going up then down on my back when jumping. Stairs – good movement, no issues going up or down. Running/changing direction – bag bounces quite a bit, shoulder hooks bends out of shape (make stiffer?) but it does feel easy.
P3	Walking – no problems. Light jog – it’s nice, shoulder hooks need to be adjust. Jumping/leaping – no problems, just wish it stay tight to the body. Stairs – no problems up and down. Running/changing direction – same comments as before. Kind of hard to adjust the shoulders once pack is on.
P4	Walking – no issues. Light jog – No big issues, pack bounces. Jumping/leaping – No big issues, pack bounces. Stairs – No issues going up. Going down, pack bounces quite a bit. Running/changing directions – pack slips at hip belt and shoulder hooks loses shape. Have to bend back.
P5	Walking – good. Light jog – backpack bounces a bit, shoulder hooks not fixed. Jumping/leaping – same issues but it stays with my body. Stairs – good up and down. Running/changing direction – a little harder without having to adjust with each move.

5. (After) Using the image, please rate (1 – barely noticeable and 5 – painful) your comfort level on the following areas

P1	Same as initial as opposed to previous testing. It is annoying to do constant re-adjustment. Where bending starts, it’s too far forward.
P2	17 & 18 – 3 (jumping/running makes backpack hit lower back). 2 & 3 – 2 (bending out of shape, pulls backwards a bit). Everything else – 1
P3	2 & 3 – 2. Everything else as first ratings
P4	2 & 3 – 3 (not physically painful, just annoying to having to bend them back). 15 & 16 – 3 (pack droops and its lower back). Everything else – 1
P5	2 & 3 – 3 (shoulder hooks keeps bending out of shape). 13 & 14 – 2 (the back is uneven). 15 & 16 – 2 (can feel backpack’s bounce during running). Everything else – 1

6. How does the general shape and size feel to you?

P1	Size is better, but somewhere between this and previous prototype would be good. Tapered bottom is nice. Back structure needs to be enveloped your back than lie flat/straight. I want it to hug me.
P2	Size and shape are fine. Is it enough space for overnight trips?
P3	I like it although, the back is too straight. The pack should be closer to my body but at times, I feels far.
P4	I like it better than the last prototype, it is smaller and condense. I like how minimalistic it looks and spacious. Wish the back panel was formed stiffer.
P5	It’s good. Looks like the size of my school backpack with less pockets.

7. How do the shoulder hooks feel to you?

P1	Bendable part should be further back. The length is nice, the radius is a bit large for my body. Fits much better than the rigid iteration. I don't feel pressure on my collarbones anymore even though it's longer.
P2	It's nice, should be stiffer. Maybe a little wider? I like I can bend as needed.
P3	I like to idea of adjustability and fits nice if it stayed bent. I do like how the hooks kind of move with your shoulders.
P4	Does not cause pain but slight annoyance having to adjust. Once adjust to where I want it, it stays. Weight of the pack is barely noticeable.
P5	Good however, it does bend out of adjustment when in movement. Kind of inconvenient which could be discomforting.

8. How does the hip belt feel to you?

P1	It encapsulates the hug comment better than the last prototype. Very good for the load bearing aspect. Placement might be discomforting for people with belly button piercings.
P2	No issues but if you want to carry more weight, it should be padded more but it works well.
P3	No problems, easy to use, tighten, wear.
P4	It could have a little more softer padding. I like the shape.
P5	Great, it sat and stayed the entire time.

9. What are your thoughts on the stability of the backpack?

P1	Only issue is the sway (left to right). Sway is always there but more noticeable and becomes annoying when going downhill. Moves well with you up and down which weirdly makes it comfortable like a suspension.
P2	It does move quite a bit when running but for walking/jogging/climbing, it does the job. You can always add more straps on the side to make the bag smaller.
P3	It moves a bit when you're running. Maybe fix the shoulder hooks to the back panel?
P4	Currently, good. Once the shoulder hooks stay to where they are bent, it would be great. The pack bounces a bit when running but so does all other backpacks.
P5	Good but could be improved. It does bounce with me so that's nice but it does hit my lower back which is not as nice.

10. Can you image yourself wearing this pack for longer duration, perhaps 1 hour?

P1	It is not uncomfortable so yes if sway reduces.
P2	Yes, maybe not like trail running but yes.
P3	Yes, after another iteration of the shoulder hooks
P4	Yes, more than the previous prototype. I like the size too.
P5	Yes, with said improvements

11. Any other comments you'd like to give

P1	It is something I am interested in if it ever hits the market. Sparks my curiosity visually and would try it on because it is different. Perhaps, would be suitable as a biking or commuter's backpack.
P2	Nope. I like the adjustable torso but currently, it's hard to get the thing through the loop.
P3	It is a very interesting design
P4	Fixed back shape and stiffer wire for the shoulder hooks.
P5	Nope.