

From ceiling *hoist* systems to ceiling *care* systems

A practice-oriented research on the effects of large-scale introduction of ceiling hoist systems

*Research commissioned by
RegioPlus
within the
framework of
Gezond & Zeker*



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Management Summary

Less back pain and increased job satisfaction with the use of the ceiling hoist systems

The Zeeland care organisation SVRZ (the Foundation for Regional Health Care) decided to replace the mobile floor-lifters with nearly 1450 ceiling hoist systems. This process was followed using a practice-oriented study on behalf of RegioPlus, within the framework of Gezond & Zeker. Before and after, questionnaires were completed by carers to map out the effects.

In the past, SVRZ used mobile floor lifters. It often takes time to find them and pick them up from e.g., the hallway, and manoeuvring them into small spaces is troublesome. Even though these aids are a solution for heavy duty lifting the comfort for both bariatric residents and residents in general is not always optimal. These floor-based lifters were soon replaced by hoist systems that are attached to rails at the ceiling. These are meant to have the following advantages: They slide smoothly along the ceiling, work quickly and easily, the daily care can be better provided, and they take up little space. These advantages are beneficial for both the carers and the clients/residents, as the daily handling and use would be more comfortable and less tiring. The research therefore focused on the exact effects of their use.

This project, unique in scope, took place during the complex COVID-19 period in which carers and residents were (and continue to be) under great strain. But they persevered and everything was installed. This means that 1450 apartments were technically prepared with the mounting of the rails, 500 lifting modules were attached to the rails, and all carers were trained in using the system. It appears it was worth the effort, as seen in this practice-oriented research. Musculoskeletal complaints were reduced in a short time. Back pain was reduced by 18%, knee pain by 42% and neck/shoulder/arm pain fell by 26%. Relevant results in these times. Nationally, roughly one third of sickness absence for care staff can be traced back to these types of complaints.

The carers were highly satisfied with the new systems and on average gave them the exceptionally high score of 9 out of 10. There were responses such as these on the questionnaires: “With this ceiling lift, there is a fantastic future. We will see improvement”, and “Less strain for my client and me. It gives the client a safer feeling”.

Other effects were also described by the carers. For this, quantitative substantiation was found in another research. This addressed the reduction of the number of lifting and transfer actions, transfer and care activities being able to be performed in less time, less time in difficult positions (static strain) and for both the carer and the client, being able to provide more comfortable care. Further research is still relevant on these points, although it concerns the expected benefits for the client's skin and the possibilities to offer clients optimal toilet-and hygiene care.

It takes courage to undertake such a big project and the associated investment, certainly in times of COVID-19. But these are concrete innovations that seem to work well and from which carers can expect to get a lot of value. The new technical aids increase the chance that carers will remain in care work. It is an example of technology that directly supports carers in their daily work and can improve the care for the clients.

Further steps may be necessary and more thorough research is certainly recommended, but we hope that other health care organisations can learn from the experiences and take comparable steps.

Foreword

In front of you is a report of a practice-oriented research into the effects of the introduction of ceiling hoist systems at SVRZ (the Foundation for Regional Health Care) locations in Zeeland. This organisation decided to replace the mobile lifting modules with hoist systems that are attached to the ceiling: ceiling hoist systems. The unique opportunity came about to generally follow this process using research. You will find the results of this in this report.

Guide

Chapter 1 introduces the report with a description of the current situation and the way the project by SVRZ fits into it. Chapter 2 follows up with a global description of the process at SVRZ. Then chapter 3 presents the research method, the research results, and the most important conclusions.

Acknowledgements

This study was performed during “COVID-19 time”: a complex period under difficult circumstances for everyone, but especially for people working in health care. The way the employees of SVRZ persevered and conducted both the introduction of the ceiling systems and the research is worthy of great admiration. This study would not have succeeded without them.

This also applies to the employees of the supplier of the ceiling hoist systems, Ergocare, who put in great effort during the entire period, moved flexibly with the limitations of the pandemic and made an important contribution to the success of the research.

We too, RegioPlus, as the client, owe many thanks for the opportunity to be able to conduct this research. We also want to show appreciation for the patience required to perform the study, with all its ups and downs, during the COVID-19 period.

We hope that the results will provide insight into the opportunities the ceiling hoist systems offer to meet the challenges in care in the coming years.

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H. 1. Introduction

Ceiling hoist systems are not new, but they have undergone enormous technical developments. That process is continually underway. We can thus speak of innovative technology. The continuing goal is to make them more comfortable, effective, and efficient. The current systems are no longer comparable in many regards with the older generations. The innovative systems now offer relevant opportunities for the challenges that healthcare is facing now and in the future. One can think of sustainable use, less physical strain, increased efficiency, and better quality of care. The expectation is therefore that there will be better chances of retaining carers for the profession and supporting them directly and substantially in their daily work. For clients this isn't only about more comfortable transfers, but also about a less painful and less tiring form of health care. However, there is still little research into the exact effects of this type of system. Even in the international professional and research literature there is only limited data found. The testing of the premises and mapping out the effects was therefore central to this practice-oriented research.

Ceiling hoist systems are still used relatively little in the Netherlands

In the Netherlands, ceiling hoist systems have been used in the past, but in general this was and is limited. National measurements also show this. The implementation, certainly of the older generation of ceiling hoist systems is minimal and does not increase significantly over the years. Based on the five rounds of the National Monitoring of Physical Strain on behalf of social partners in care, it is constantly recommended to use ceiling hoist systems more intensively (Knibbe et al., 2016). It appears that only 0.9 to 1.5% of the lifting actions are performed with a ceiling hoist system. This percentage hardly changed since then over the years and is now around 5-10%. That is a strong difference with the percentage of 30-40% in countries such as Sweden, Norway, and Canada, for which limited data is available. It is not completely clear what causes this strong difference. It may be traced to the forerunner role that our country had in the use of mobile, floor-based lifters. At that time there were beneficial subsidy options for this. Then that led to a strong use of these lifters and a reduction in the physical strain for carers. The Netherlands was a leader worldwide at that time. These conventional floor-based lifters generally have a depreciation time of around 10 years, and it is thus not financially attractive to replace them early. They now need to be replaced gradually. The transition to ceiling hoist systems for the coming years is at hand where technically possible and feasible for health care. It is expected that mobile lifters will continue to be available in situations where this is desired in care situations or where it is not technically possible to attach the systems to or along the ceiling. Even for the active (semi-standing) lifting modules, there are not enough coverage options available. We refer to the possibility of motorising them to move across the floor, thus limiting the physical strain of manoeuvring in any case. Delimitation with or even in combination of both types is not the subject of the study.

Innovative or not?

The fact that the ceiling hoist systems “hang from the ceiling” is not new. What is new is that they not only must be used more for lifting from A to B and vice versa (such as from bed to wheelchair and wheelchair to toilet). In principle, there may also be other sources of physical heavy duty addressed. We are then talking about the main groups “lifting and transfer actions within the limits of the bed”, “pushing, pulling, and manoeuvring” and the “working for a long time in difficult positions”

(static strain). These three remain significant bottlenecks in care. Especially, the static strain appears difficult to solve. It forms an underestimated yet very important and possibly THE most significant cause of long-term absenteeism at older ages in care.

The new generation of ceiling hoist systems may solve part of that problem.

In addition, multiple actions (and thus not alone lifting and transfer actions) can be combined, through which one can work more effectively and efficiently. We are then talking, for example, about the integration in actions around skin care (decubitus risks (from lying down)), incontinence care, dressing and undressing, etc. By laying on a sling and having this attached to a suitable ceiling hoist system, it may be possible to optimally complete the entire care cycle. Currently, some of the actions must be performed by 2 carers. They can then possibly be carried out optimally by one carer.

This means that the new generation of ceiling hoist systems may have more to offer in the form of contributing to solutions for a number of significant bottlenecks: static strain, effectiveness and working pressure. The more traditional advantages will still exist such as less space requirements and less physical strain by lifting, manoeuvring, pushing, and pulling in small spaces etc. Perhaps we should, considering the expansion, finally take the step to speak about ceiling *care* systems.

However, many care organisations are struggling with the substantial investments in ceiling hoist systems and have insufficient insight into the implementation problems and solutions, as well as the financial implications (training, servicing, etc.). Some also have already heavily invested in the conventional mobile lifting modules and hesitate to make new investments, certainly in existing buildings. The SVRZ project shows, however, that installation in existing buildings is also possible and is therefore extra relevant to follow.

The use of the new generation of ceiling systems may contribute to a better quality of work and quality of care. More research is required so that one can make informed decisions for one's own organisation. This project should be a first step in the right direction for both.

Jumping on a moving train

Research into this type of interventions with ceiling hoist systems has previously been requested, but usually fail due to

1. the enormous costs that the intervention itself costs in materials and
2. the long run time of research requests through which this type of research opportunities cannot be utilised quickly and alertly enough.

This opportunity did arise at the SVRZ. However, requirements were set for the research. The strain for those involved must be minimal. However, we had the opportunity to measure a number of important indicators.

SVRZ: Foundation for Regional Health Care

The research took place at the Foundation for Regional Health Care (hereafter SVRZ) and was performed with its cooperation. SVRZ provides care to vulnerable elderly people in Zeeland who need care and support for a short or long period because of physical symptoms or memory problems. SVRZ is a large care group with approximately 3067 employees in paid employment, consistent with 1974 FTEs (<https://www.svrz.nl/kerngegevens/>). SVRZ has a fine network of provisions for vulnerable elderly people throughout nearly all of Zeeland. Both in the neighbourhoods of the Zeeland cities as well as in the villages the entire array of basic to specialist care is offered. This is done from centres for care and rehabilitation, nursing services, 36 residential care centres, but also at the clients' homes.



H. 2. The use of ceiling hoist systems at SVRZ in general

2.1. Preparation and phasing

The use of the ceiling lift system at SVRZ was thoroughly prepared and was executed in phases for the practical part. Globally speaking, we can recognise two phases in this.

2.2. Phase 1: Pilot in one room

First a pilot was executed in which a complete ceiling hoist system was installed in one room. This system was then thoroughly evaluated by the affected parties from multiple angles. This evaluation was positive and resulted mainly in the following findings.

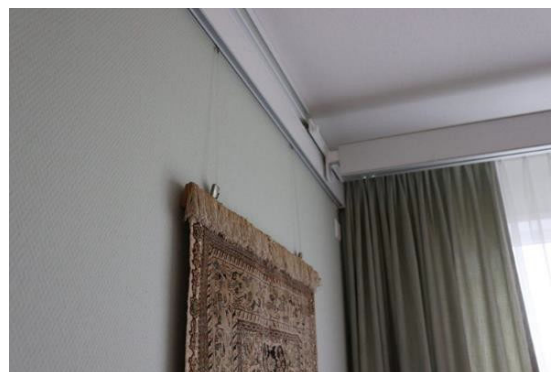
X-Y-system

A ceiling hoist system is installed according to the X-Y system. This means that there is a horizontal mobile rail at an angle of 90 degrees attached to two fixed wall rails and can move freely along them. The lifting module with the so-called lifting hanger moved along the mobile rail, so every place in the room can be reached. The lifting module with the motor is attached to the cross-rail and the lifting hanger can move up and down. The client is then located in a lifting sling that is attached to the lifting hanger. The choice for this type of system and not for fixed, single rails (X) is an important and rather principled one. With a fixed rail, one is bound to the area of the track: only the area exactly under the rails can be reached and even small adjustments are hard to make. The options are many times greater with a mobile X-Y system, but the costs are higher, and the installation is more technically complex. It is also important here that the system is installed in an existing building. The option exists to do that with rails along the wall, so that the requirements of the ceiling are less high. This is not possible with all brands. The idea exists that the installation in an existing building may not be possible. The SVRZ approach shows that this is possible after all. The maximum weight per wall rail is 255 kg and thus also sufficient for a heavier group of clients. This may possibly be expanded with another lifting module to an upper limit of 300 kg.



Non-disruptive

The X-Y system did not appear to be a disruptive element in the room. The rails are almost invisible and are mounted against the wall. The rails can optional be equipped with picture hangers and be equipped with LED lighting. This type of system is much less prominent in its presence than a mobile lifting module. On the other hand, a mobile lifting module can be fully removed from the room after the transfers.



Because every corner of the room can be reached, there is also better accessibility around the bed. A mobile lifter has less of that, does not always fit between the wall and the bed, so that sometimes the bed must be moved to be able to use a mobile lifter. The pilot indicates that a ceiling hoist system offers a more comfortable way to move a client. The client can be moved without great strain through the smooth course of the mobile rail and the lifting module. Finally, it was reported that a ceiling hoist system has a lower chance of physical pain through the low strain when manoeuvring.



Ultimately, the following characteristics were listed by the participants in the pilot phase:

- The lifting module itself is simple to attach and detach from the mobile rail. By only using lifting module where needed, costs can be saved.
- Contrary to a mobile lifter, a ceiling hoist system is always available and at hand in the relevant room.
- With a mobile lifter there is usually only one available in a residence, which then must be used in multiple rooms.
- By using ceiling hoist systems there is less space necessary for storage of lifting aids.
- It is possible to design the lifting module with a scale unit (as with many mobile lifters).
- In rooms where the lifting module is not needed, it is also not a “disruptive” element in the room.
- The wall rail is relatively easy to mount on the wall.
- The care workers are very enthusiastic about working with a ceiling hoist system and prefer working with a 2-point hanger bar instead of a 4-point hanger bar. The client is more stable and comfortable in it¹.

2.3. Phase 2: Final deployment and choices

Ultimately it was decided to prepare 1450 rooms for the ceiling hoist system by installing the wall rails. The only thing that is then required to make the system operational is the attachment of the lifting module with the motor. About a third will be equipped with a lifting module thus the number of operational systems will be about 500.

It was finally decided to use an X-Y system. A wall rail is mounted on both sides of the client room. A horizontal beam moves between these rails that utilises the entire room. A lifting module hangs on the beam with a hanger bar to which the personal sling can be attached with a loop system. All slings and lifting accessories are tailored to the client. It was chosen to design the ceiling hoist system to reach the bathroom. In the bathroom itself, an ergonomic shower chair can take over care tasks, but the system does not fully work to the bathroom.

Before they work with the ceiling hoist systems, all employees are trained in its use for part of a day in a demonstrable and defined training course.

¹This choice also applies to mobile lifting modules. This note is a result of the pilot, but not specific for ceiling hoist systems.

Implementation was started in 2019. The plan was to have it ready to use at the end of 2020, but the outbreak of COVID-19 stopped work for about half a year. Everything was finally completed in September 2021.

Cooperation with the supplier, Ergocare

In a project such as this, it is necessary to work closely together with the supplier, after all, it is ceiling hoist systems that must be installed, and this is not easy. A project like this requires tailored solutions to install in an existing building. Precise scheduling is also crucial. Not only does the installation have to be well timed, but the education and training of employees must also be focused on this. Lifting modules are aids that require good and certified training for the carers before they may work with this type of lifting module for the safety of both the carers and the clients. The mobile hoists were also removed, and therefore it was very important that the employees were trained on time. The entire logistics system required a close cooperation between SVRZ and the supplier. The fact that the COVID-19 pandemic broke out provided an extra challenge.

Compared to conventional mobile systems, the first introduction requires more technical adjustments: the installation. The additional training is comparable: in both situations, training must take place before use and each person must be documented and signed off. The use of the ceiling hoist system is not complicated as such, nor is it perceived as complicated by the caregivers. SVRZ has chosen to work with Ergocare, a company that has been bringing ceiling hoist systems to the market since 1996 and has supported the installation, implementation, and servicing. Ergocare is an importer of the Guldmann products, one of the largest players on this world market. Ergocare was actively involved in the project, but had no influence on the research, analyses, or the reporting.

3. Methods and Results

3.1. Introduction

The study took place using short questionnaires prior to the use of the ceiling hoist systems and, with a subsequent measurement, after a period of familiarisation. The questionnaires were validated based on the NORDIC Questionnaire for Musculoskeletal Disorders as the measurement instruments used in the five nationally monitoring rounds for physical strain in care (Knibbe et al., 2016). This allowed us to compare with large, national reference files. The lists were kept very short to limit the pressure on the affected parties as much as possible. That was from the start an important requirement to be able to follow the process with research.

As indicated, the study was limited in design and implementation due to the hindrances surrounding the COVID-19 pandemic. This had influences on both the intervention itself as well as on the measurements. As researchers, we wanted to participate in the training, such as when the pandemic first started. Afterwards, it appeared that this would be the provisional last meeting. The questionnaires were handed out right at the training meetings and so it became a process of trial and error. The process had to stop now and again but was able to resume afterwards.

For that reason, data collection required a long period of time. The results below are based on the data that came in through August 2021. The baseline measurements were performed prior to the first use. The subsequent measurements were made after people were able to gain experience. This period can change and it was not a fixed period.

Thanks to the perseverance of all the parties involved, we obtained a good data set. Ultimately there were enough participants involved in the research, so we were able to draw responsible conclusions.

When presenting the results, we used the results of other studies and data collections. Thus, we were able to supplement the results and compare with other sources. Where we have done that, we have explicitly noted this.

3.2. Population

The received a high number of responses to the questionnaires. To make sure that the right people were asked to participate, and the right timing was followed, they were handed out during the training meetings: i.e., explicitly before the use of the ceiling hoist systems. The carers received very targeted training in small groups for a few hours that was strongly tailored to the optimal and safe use. Participation was obligatory and had to be signed off. In this way, the safety requirement that the users of lifting modules and thus also these special versions “must be demonstrably trained” prior to use was met.

By participating in the research in this way, good administration was ensured. Participation in the research was, contrary to the training, completely voluntary and anonymous. There were agreements made with SVRZ about the data to be collected and the protection of the anonymity of the participants. Statements regarding this were provided in advance by the researchers.

Number of participants

A total of 412 respondents took part in the pre-measurement. The number of responses was high, above 90%. For the subsequent measurement, a smaller group was invited to participate due to the complex situation. This group was harder to reach because the training had already been done and the pandemic had hit at its hardest. In the follow-up measurement with this smaller group, 177 carers participated. The response here too was rather good, those invited also generally took part. The rate of responses was above 80%, which is very good for this type of research.

General characteristics

In the preliminary measurement 93% of the carers were women. The average age was 43.2 years, with an average experience of 17.9 years. In the follow-up measurement, 89% of the respondents were women. The average age was 40.7 years and experience was an average of 15.3 years. There are thus small, but not significant differences between both groups. There were corrections where necessary. The group is comparable in age, work experience and gender with the total group of carers in the CARE in our country.

3.3. Musculoskeletal complaints

Many employees in CARE (home care, nursing, and care homes) must deal with heavy duty physical work. This may be lifting/transfers of passive clients, but also difficult positions when providing care (wound care, continence care, washing, showering, etc.). Physically straining activities can, if too stressful, lead to symptoms of the musculoskeletal system. Complaints of the musculoskeletal system form one of the most significant causes of absenteeism and inability to work. Approximately one third of the absenteeism in care is attributed to this.

Therefore, explicit guidelines have been agreed for physically strenuous work: The Practice Guidelines for Physical Strain. An important and collective objective is that by applying these guidelines, promoting a good prevention policy in institutions. This can reduce exposure to physical overload, which in turn can reduce the number of employees suffering from musculoskeletal complaints. This can also reduce the associated absenteeism and inability to work and in doing so, the chance of retention is increased. It appears that this approach is indeed effective. For details on this, we refer to the research that have been performed (Knibbe et al., 2001, 2003, 2005, 2008, 2016).

The inspectorate for SZW oversees adherence to these practice guidelines. They form the testing framework. They are also included in the CEN ISO TR 12296 and are part of the national ARBO catalogues that have been agreed upon by the social partners and the government. The use of ceiling lifts fits in seamlessly with these practice guidelines and potentially solves an important category of physically too strenuous actions: the strenuous actions are assumed by a lifting module and in this case, ceiling hoist systems. The expectation is that the percentage of carers that indicate having back problems and other musculoskeletal complaints will fall.

This research therefore looked at the incidence of musculoskeletal complaints among SVRZ carers before and after the ceiling hoist systems were used, using a number of standard measures in this field.

Back problems last 12 months

First the question was asked: "Have you had problems with your back in the last 12 months?" This general question refers to the 12-month prevalence and is a standard question in epidemiological

research (in this case, originating from the NORDIC standard) that makes it possible to compare and interpret research outcomes. There is, for example, also data known from the RIVM and from occupational groups outside of care that were collected with an identical question. The average for the female general population varies around 40-42% (RIVM div, from Picavet et al. 2000-2001 - 2020). For care, percentages of around 55-65% were measured (see Knibbe et al div). Above all in the physically demanding sectors in care (home care, elderly care) there are some outliers of more than 70%. With an optimal prevention policy, this falls to the national average for women of about that age; about 40-45%.

We see in the baseline measurement at the SVRZ that 62% of the carers reported having back pain over the last 12 months. The 12-month prevalence appears to have dropped in the subsequent measurement to 54%. For a relatively short period this is a considerable drop (see fig. 3.1). There is still room for further improvement. It is important to note that there is talk of a certain latency period: meaning that it will take some time for the intervention to work. It is of course about preventative interventions that may work for people who already have problems, but this takes more time (Knibbe et al 2016). All in all, we consider this a significant drop, even in this relatively short period.

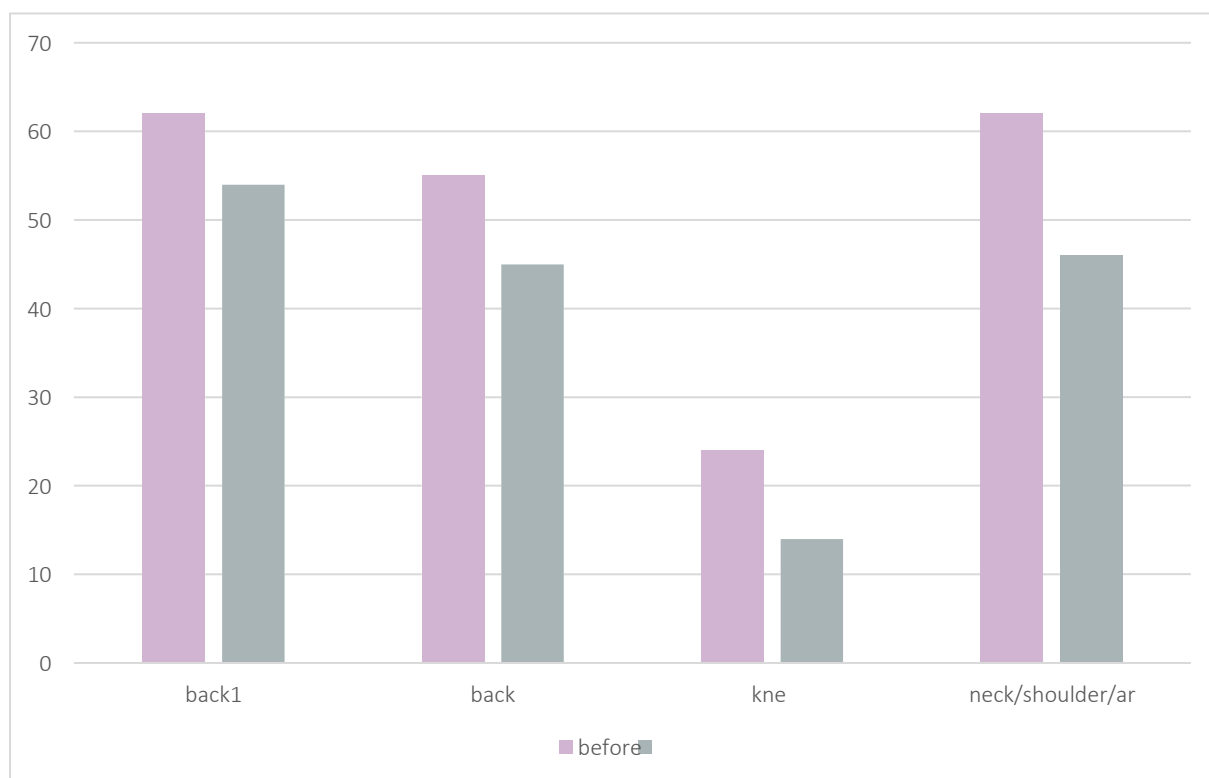


Figure 3.1. Percentages of carers with musculoskeletal complaints (before n1= 412, after n2 = 177) (*back pain in the last 12 months, back pain in the last 3 months, knee pain in the last 3 months and neck/shoulder pain in the last three months*)

Other musculoskeletal complaints

Back problems are not the only type of problem for the musculoskeletal system. Neck/shoulder/arm complaints appear to occur relatively often in carers and regarding volume as the reason for absenteeism, even exceed that related to back problems (Knibbe et al., 2016). Table 3.1 and figure 3.1 show an overview of the data regarding problems with the musculoskeletal system over the last three months. For comparison, here too the data on back problems in the last three months were placed in the table. In table 3.1 it is visible that neck/shoulder/hand/wrist problems occur very often (62%): certainly, if we consider that this is regarding problems in the last 3 months. The causes of this type of complaint must be sought in all forms of static strain (such as working in difficult positions during washing, dressing, wound care, showering etc. of the clients) and pushing, pulling, hauling, and manoeuvring such as with heavy duty materials (such as moving and manoeuvring heavy duty materials like floor lifts, meal carts and shower stretchers) than in the lifting and transfer actions of clients. Nationally, the great scope of this problem is also visible and marked as a bottleneck very often (Knibbe et al., 2016).

From the analyses of Bronkhorst (2014) we can also see that static strain is strongly correlated with absenteeism and while this type of work in uncomfortable positions (static strain) is related to continuing to work with problems. Previously, research (Knibbe et al., 2008) and research by Jansen et al (2004) and, from Germany, from Freitag et al. (2011) showed us that static strain is a significant factor and represents the strongest connection with long-term absenteeism due to back problems (RR of 3.2, Jansen et al, 2004).

Compared to the previous measurement, in the subsequent measurement there was a significant reduction over the entire line. The percentage of carers with back pain in the last three months has dropped and that is also significant for the neck/shoulder/arm complaints and the knee pain had been reduced considerably.

Table 3.1. Percentages of carers with musculoskeletal complaints in the last 3 months (n1= 412, n2 = 177)
(back pain in the last 12 months, back pain in the last 3 months, knee pain in the last 3 months and neck/shoulder pain in the last three months)

	First measurement	Subsequent measurement
<i>Prevalence of problems last 3 months</i>		
Back problems	55%	45%
Knee problems	24%	14%
Neck/shoulder problems	62%	46%

Subgroups as a risk group

In the national monitoring rounds on behalf of social partners we see a great deal that within the group of carers more problems were reported by the younger people (< 30 years) and the older people (> 55 years). According to a specific question from SVRZ, we also looked at the data set to see if that was also the case here. It did indeed appear that particularly the younger group reported more problems, but also the older group scored higher. Knee pain occurred more often in the older

group. We do see that for both groups there is a clear difference between the first and second measurements. This emphasises the potential positive influence on retention of these carers also in these risk groups. An overview of the results of both groups is shown in table 3.2 and table 3.3.

Table 3.2. Percentages of carers younger than 30 with musculoskeletal complaints in the last 3 months (n1=85 and n2=45)
(*back pain in the last 12 months, back pain in the last 3 months, knee pain in the last 3 months and neck/shoulder pain in the last three months*)

	First measurement	Subsequent measurement
<i>Prevalence of problems last 3 months</i>		
Back problems	62%	55%
Knee problems	18%	14%
Neck/shoulder problems	68%	41%

Table 3.3. Percentages of carers older than 55 years with musculoskeletal complaints in the last 3 months (n1=94 and n2=26)
(*back pain in the last 12 months, back pain in the last 3 months, knee pain in the last 3 months and neck/shoulder pain in the last three months*)

	First measurement	Subsequent measurement
<i>Prevalence of problems last 3 months</i>		
Back problems	56%	48%
Knee problems	41%	23%
Neck/shoulder problems	67%	46%

The absenteeism was not measured in this research. The design is not suitable for that. From other research it is known that absenteeism due to back problems in the age group 55 plus is 1.3 times as great than that in the age category of under 55 years. Moreover, these are mainly long-term absences. It is a good sign to see that at SVRZ the prevalence of complaints dropped even in this older group. There is a real chance that this will also have an influence on absenteeism, but further research over a longer period is necessary for this.

3.4. Valuation for the ceiling hoist system

High appreciative score

In the last measurement we asked for a report score for the new ceiling hoist systems. These scores are especially high compared to other research of other aids (Knibbe et al., div). The average report score was 8.97, so we rounded up to a 9.0. This great enthusiasm was also seen in the very extensive reactions we received to the open questions on this point. We bundled these answers. You will find a very summarised overview of them below.

Open remarks: positive aspects

- *Self: less physical strain and smooth. Clients: also, less strain 29x*
- *Nicer in smaller spaces, hoist system always at hand, is ready in every room 9x*
- *Faster, more time for care, easier to work 8x*
- *Lighter to use, always on hand, no possibility of entrapment of the clients because the hoist system stops 6x*
- *More space in the room/working space, more visibility, easier placement in the chair 4x*
- *It takes up little space and it is easier to place clients in the chair 3x*
- *Really relieves the entire body*
- *I think the ceiling hoist system is ideal*
- *Closer and better contact with the client*
- *You can work more independently*
- *There is a fantastic future with the hoist system, now improvement is coming*
- *These aids. Thank you!*
- *Great atmosphere, less stress, trust, taken seriously. Working with each other, all disciplines, instead of fighting to get it done for the client.*
- *I am happy with the layout of the ceiling hoist*
- *You can nearly always help a client with the ceiling hoist*
- *Works without force/difficulty, plenty of space around the client, client feels safer*
- *Easy to use, near where you need it, many options*

Open remarks: negative aspects

- *Not always possible to get into the bathroom with the ceiling hoist system 18x*
- *For obese clients, sometimes problems and/or the slings are taut in the groin in combination with the heavy stomach 4x*
- *The clients may sometimes find it a bit tight in the beginning, but that is only sometimes: otherwise, it works 3x*
- *Good support of the client is important, otherwise they may feel unsafe, certainly in the beginning 3x*
- *Tips and opportunities to continue to use the toilet/ e.g., at the point where someone is no longer safely in an active lifter, but is incontinent and wants to stay 3x*
- *Put a brake on the hoist system so that it is stable during wound care, in the leg sling the lifter/yoke launches away quickly and the yoke wobbles 2x*
- *You cannot electrically control the seat position if the person is in it 2x*
- *Suspension system remote control always comes off the wall 2x*
- *Shower mat is wet and cold*

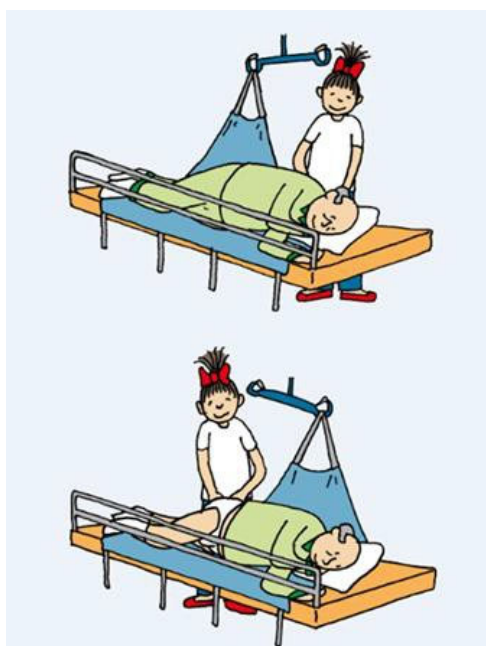
3.5. Explanation of other effects

Using other research and measurements that we performed into the use of comparable ceiling hoist systems in elderly care, handicapped care and in hospitals, we can supplement the results from SVRZ. The carers of SVRZ named the aspects below in their responses to the open questions, but we cannot quantitatively support them based on the results of their questionnaires. This is possible using other measurements that we and others performed. But we do recommend further research on this.

Number of lifting and transfer actions reduced

Compared to mobile lifting modules, the number of heavy lifting and transfer actions is reduced. Research have shown that this can be significantly and substantially reduced: by 28-47% per 24 hours (Knibbe et al. 2015). This is primarily caused by the ability to combine multiple transfers into 1 transfer, both the transfer itself as for the provision of care (such as continence care, dressing and undressing, wound care, etc.). This is not about a less physically straining manner of performing a transfer but avoiding the need for the transfer overall. In other words: eliminating the number of transfers. This leads to a lower exposure to physical overload and takes substantially less time. This is strongly dependant on the group of clients and the design of the type of ceiling systems. Thus, it is decisive how passive the group of clients is. In the group that remains in bed a great deal and receives care there (D/E), the effect will be great to very great and in the group that is much more mobile and independent, this effect will be more limited. The type of ceiling system is also decisive. A single-track system is less effective on this point than the system chosen by SVRZ, whereby the system can cover the entire room and is not bound to the rail itself. It is also important here that the sling/mat can stay under the client and is suitable for this. This does not apply to all types of slings. When using a sling not specifically designed for this, the guidelines cannot be met for avoiding decubitus and this would be undesirable from a care point of view.

An example of transfers and care actions that can be combined is visible in the figures below. In the "old" situation, multiple transfers would be needed for this (upward, sideways, swivelling, (better) positioning etc.). In the new situation, through selectively loosening part of the straps of the sling, while the client stays well supported through the ceiling system, the lower body or even the upper body of the client can be treated (washing, wound or incontinence care, skin care and dressing undressing). If this is a lifting sling is permanently positioned under the client and is breathable, the client is always ready for a transfer and this doesn't cause him/her any pain or effort. The latter also applies to the carer. The sling does not have to be put under the client first and removed afterward. This may also have a positive influence on the skin of the client.



What is notable is that the transfer will be an integral part of the care process as well as the carer that chooses this in the interest of the client. The ceiling system has thus become an instrument that helps the carer to provide optimal care and not only to ease a lifting or transfer action. It underlines the development of lifting aids to care aids, as we stated earlier.

The transfer time is reduced

Both our own measurements in earlier research as well as other measurements published by others (e.g., Curran et al 2020) show that the duration of the transfers are reduced by 60-120 seconds. This reduction is related to the comparison between a transfer with a mobile lifting module and a ceiling hoist system such as that in use at SVRZ: namely the traverse X-Y system whereby a cross beam can move freely between two rails to be able to cover the entire space. The process itself is quicker and more efficient, but as indicated by the carers of SVRZ: the lifting module is always ready for use and at hand. "You don't first have to go and look for a lifting module."

If we make considerations based on the average number of transfers, we know that, depending on the type of care being provided, there will be 7 to 8 transfers performed, mostly for a less independent, passive client (mobility classes CDE, Knibbe et al. 2016) per day. Every 24 hours, in doing this there will be a shortening of the transfer time of 7.5×90 seconds. Calculated per client, we come to approximately 11 minutes per client per day of time that is "freed up" for other tasks. This applies only for passive clients: so those that need a lot of help for all daily actions. There are always departments/residences where clients live who are completely mobile and do not need lifting modules. The shortening of the time required will not be seen there. From national monitoring (Knibbe et al. 2016) we can derive an average about the degree to which clients need help for lifting and transfer actions. In this we see that about 75% of clients in a care home setting need substantial help with transfers and if some are completely passive and therefore need lifting modules (mobility classes C, D and E, Knibbe et al., 2016). Assuming a group of 30 clients for example, of which 75% need a lifting system, we come to "freeing up" of about 4 hours per day. For a care home situation, the national monitoring reports an average of 37% of the residents that need a lifting module there. Then, for a group of 30 clients, we calculate about 2 hours per day of extra time. Further research will be able to improve these types of global calculations and better justify them.

We also want to emphasise the risk that arises here. The time freed up will not directly lead to a reduction in formation scope. If that happens, the possibility of work pressure and the chance of physical overload on an individual level is equally as great for each carer. He or she will then, for example, must care for more clients in the same period and thus may undergo heavy or heavier duty. We call this the "ergonomic drop". With this potential and realistic savings, one must be careful to also maintain this now for the large area present at SVRZ. The most solution most often used for this is earmarking of a part of this time in every case to be able to work more calmly, to be able to perform other tasks that could not be done before ("care left undone"; Senek et al. 2020) and to curb the (experienced) work pressure.

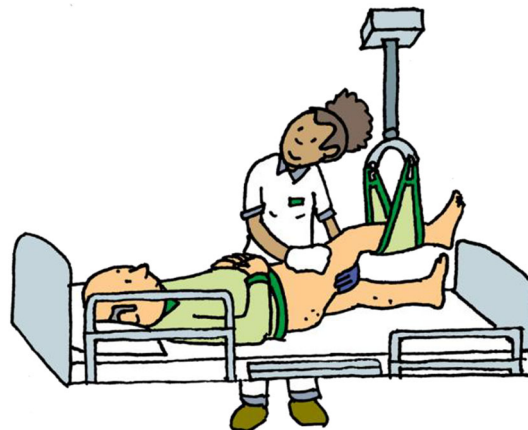
Very often, the carers at SVRZ have reported within the framework of further efficiency that they would like to see the system extended to the toilet/bathroom. In theory, this might provide further time savings, but one must look at that more closely.

Static strain is reduced significantly, working less long in cranked positions (RR 3.2 with long-term absenteeism)

Having to work in a cranked position for long periods may not involve lifting actions, but in care forms an important but underestimated cause of long-term absenteeism through back problems. The relative risk to carers of the development of long-term back problems caused by having to remain in difficult positions regarding those that do not have to is 3.2. This means that the chance of back problems is significantly greater than the risk caused by heavy lifting (Jansen et al., 2004).

The ceiling systems make providing care on a bed or elsewhere easier; the position in which one must work is in a less cranked position and the actions are completed more quickly (Knibbe et al., 2015). The lifting module is not in the way and one can get closer to the client.

The special accessories are also handy at this point. Thus, one can use a special sling to just raise a leg to provide good (wound) care without the leg having to be being held up or that one must stand in difficult positions.



Less heavy-duty manoeuvring

Manoeuvring with a mobile lifting module is no longer necessary. The pushing, pulling and always having to stop and start can be strenuous with a lifting module with a client in it. Certainly, if there is limited space available and if the precise position is tight (such as above the toilet). This leads to lots of start and stop movement with associated peak forces (Knibbe et al., 2016). A ceiling hoist system takes up less space and slides over the rails, so it is much less heavy duty.

Necessity to work with two carers is reduced

In principle, care provision with ceiling hoist systems can be performed with 1 carer. We see that come up in the responses to the open questions. As illustrated in the drawings above, one carer can perform the actions very well with a ceiling hoist system. In the old situation there is usually an extra carer required to keep the client stable and comfortable in the optimal position for care on the bed. Now there are also mobile systems that offer this support option.

Other research show that the percentage of actions performed with two carers differs strongly, but this is the case with about 4-5% of the clients with outliers of up to 20%. There will always be a necessity for two carers to care for a client for reasons other than transfer (such as an aggressive or very anxious client), but this necessity may well be reduced with this type of system. One could think of the necessity to keep a client in a stable position during washing (tilted position) or to support a leg or an arm. Thus, we can also speak of a more efficient form of provision of care.

Comfort for the client as well as the carer increases significantly, contact / communication with the client improved

This has also been mentioned many times by the carers of SVRZ and is recognised as an effect from earlier research into the experience by clients with ceiling hoist systems (Knibbe et al., 2015).

The additional potential effects as those listed below cannot be quantitatively substantiated. It would be worth the effort to perform further research into this. If it is regarding quality of care and the prevention of consequential damage (such as incontinence or bed sores), this can also contribute to the quality of care and cost efficiency of this type of solution.

- Indications of better skin quality/less skin damage for the client
- Influence on the client's ability to go to the toilet

Regarding the last point, we see that going to the toilet can be a problem popping up in the open questions. It is very important not to lose sight of this. The fact that the ceiling systems are not extended into the toilet may mean that this would lead to heavy lifting if the client were in a position to go to the toilet with help and thus can remain completely or partially continent. Now and then problems are reported with this activity and it appears recommended to look at this closely so that the clients do not have to go to the toilet less often or with great difficulty for themselves and the carers. Usually these may be clients who, for example, still have some ability to stand and are eligible, for example, to go to the toilet with an active lifting module. There are options to use a ceiling hoist system to achieve an active, semi-standing position (the so-called STAID), but this is not an aid suitable for all clients. The specially designed toilet lifting slings are also not a standard solution even though there are positive developments. A great number of the clients can be helped in this way. This remains a focus and there is express cause to do further research.

3.6. Conclusion

After the installation of and the training in the ceiling hoist systems, the percentages of carers with musculoskeletal complaints have decreased. This applies to back problems, knee problems and neck/shoulder/arm problems. Within the group of carers, the younger and older groups form a particular risk group with increased prevalence. But even among them we see a significant reduction in the percentages.

The appreciation of the carers of the ceiling hoist system is particularly high with an average report score of 9. In the assessments we see a great variation of positive experiences and a few negative ones.

From other sources, we can substantiate the remarks of the carers at SVRZ more quantitatively. Then we see that the number of heavy transfers is considerably reduced (elimination of the necessity of transfers), that time is freed up, one must work in a difficult position for less time (static strain), manoeuvring is less strenuous, less necessity of working with 2 carers, and the comfort of and communication with the client is improved. More detailed research should show whether there is a question of advantages or disadvantages for the client's skin and ability to go to the toilet for clients for whom that is possible.

One must be warned of the ergonomic drop: namely that the care time that is now "freed up" leads to a smaller formation scope and that for the individual carer must do more in less time. Then the advantages for the health and retention of carers could quickly evaporate. There are arguments for earmarking part of this time for carers themselves to work under less pressure and for the performance of the so-called "care left undone".

The study was performed under complex conditions as the result of COVID-19. This has created limitations in the planning, timing, design, and scope of the research. This type of research should preferably take place under more controlled conditions. We would also like to have gotten to measure the exact exposure to physical strain and the intensity of the actual use of the ceiling hoist systems. Considering the results, we recommend doing further research to get further and stronger substantiation of the effects (time, physical strain, quality of care, etc.) and in addition create a financial cost-benefit analysis (business case) using the effects and the experiences at SVRZ and other organisations.

All in all, the results are overall very positive.

References

- Alamgir, H., Li, O.W., Yu, S., Gorman, E., Fast, C., Kidd, C. (2009). Evaluation of ceiling lifts: transfer time, patient comfort and staff perceptions. *Injury* 40 (9), 987e992.
- Chhokar R., Engst C., Miller A., Robinson D., Tate RB., Yassi A. (2005). The three-year economic benefits of a ceiling lift intervention aimed to reduce healthcare worker injuries. *Applied Ergonomics*, 17 Jan 2005, 36(2):223-229.
- Curran, J., Fray, MJ. (2020). Time savings with ceiling track hoist systems, *Column digital*, 32.2, 2020, 10-15.
- Dawson A.P., McLennan S.N., Schiller S.D., Jull G.A., Hodges P.W., Stewart S. (2007). Interventions to prevent back pain and back injury in nurses: a systematic review. *Occupational and Environmental Medicine*, 64: 642-650.
- Engst, C., Chhokar, R., Miller, A., Tate, R.B., Yassi, A., (2005). Effectiveness of overhead lifting devices in reducing the risk of injury to care staff in extended care facilities. *Ergonomics* 48 (2), 187-199.
- Freitag S., R. Seddouki, M. Dulon, JF Kersten, TJ Larsson, A Nienhaus. (2014). The Effect of Working Position on Trunk Posture and Exertion for Routine Nursing Tasks: An Experimental Study, *Ann. Occup. Hyg.*, Vol. 58, No. 3, 317–325.
- Hegewald, J., Berge, W., Heinrich, P., Staudte, R., Freiberg, A., Scharfe, J., Girbig, M., Nienhaus, A. and Seidler, A. (2018). Do Technical Aids for Patient Handling Prevent Musculoskeletal Complaints in Health Care Workers? A Systematic Review of Intervention Studies. *International Journal of Environmental Research and Public Health*, 15(3), p.476.
- Hignett, S., M. Fray, N. Battevi, E. Occhipinti, O. Menoni, L. Tamminen-Peter, E. Waaijer, H. Knibbe, M. Jäger, (2014), CEN/ISO TR 12296-2013 Ergonomics – Manual Handling of People in the Healthcare sector, *International Journal of Industrial Ergonomics*, Volume 44, Issue 1, Pages 191-195.
- Holtermann A, Clausen T, Jørgensen MB, Burdorf A, Andersen LL. (2013). Patient handling and risk for developing persistent low-back pain among female healthcare workers, *Scand J Work Environ Health*, 39(2):164-169.
- Holtermann A., T. Clausen, M. Birk Jørgensen, B. Aust, O.S. Mortensen, A. Burdorf, N. Fallentin, L.L. Andersen (2015). Does rare use of assistive devices during patient handling increase the risk of low back pain? A prospective cohort study among female healthcare workers, *Int Arch Occup Environ Health*, 88:335–342.
- Humrickhouse R, Knibbe JJ (2016) The Importance of Safe Patient Handling to Create a Culture of Safety: An Evidential Review, *The Ergonomics Open Journal*, 9, 1-16.
- Jäger, M., C. Jordan, A. Theilmeier, N. Wortmann, S. Kuhn, A. Nienhaus, A. Luttmann (2013). Lumbar-Load Analysis of Manual Patient-Handling Activities for Biomechanical Overload Prevention Among Healthcare Workers, *Ann. Occup. Hyg.*, Vol. 57, No. 4, pp. 528–544, 2013.
- Jansen J., Morgenstern H., Burdorf A. (2004) Dose response relations between occupational exposures to physical and psychosocial factors and the risk of low back pain. *Occup Environ Med* 61(12): 972–9
- Jung, Y. and Bridge, C. (2009). The Effectiveness of Ceiling Hoists in Transferring People with Disabilities. pp.1-22.
- Knibbe, JJ, NE Knibbe, EW Waaijer, (2012) Flying through the hospital: efficiency and safety of an ergonomic solution, *Work* 2012;41 Suppl 1:5642-3.
- Knibbe, JJ., Knibbe NE. (2015). Evaluation of a novel bed sheet used to reposition and transfer patients in an intensive care unit, (2015), *British Journal of Nursing* Vol 24 Issue 6, 19-23.
- Knibbe, JJ., Knibbe NE. (2016). Landelijke Monitoringsrondes Fysieke Belasting VVT in opdracht van sociale partners, 1999-2016. *LOCOmotion, Sectorfondsen Zorg en Welzijn, Den Haag / Bennekom*.
- Knibbe, JJ., Knibbe NE., (2015-2020). Diverse instellingsgebonden onderzoeken naar de inzet van plafondtilsystemen, *LOCOmotion, Bennekom* (niet openbaar).
- Knibbe JJ., Waaijer EM. (2020). COVID-19 and Safe Patient Handling and Mobility in The Netherlands *Int J SPHM*, Volume 10, Number 2, 80-82 (2020).
- Knibbe, JJ., Knibbe, NE., Van Vught, F. van, (2008). Markante Marges, effectieve innovaties in de directe zorg, *St. RegioPlus, Zoetermeer*.

Knibbe NE., Knibbe JJ. (2016). Assessing health and safety risks in the hospital sector and the role of the social partners in addressing them: the case of musculoskeletal disorders (MSDs) and psychosocial risks and stress at work (PSRS@W). Report of the social partners' conference on approaches to the issue of psychosocial risks and stress at work in the hospital sector. HOSPEEM / EPSU Helsinki - 10 November 2015 (2016).

Knibbe NE, Zwaenepoel E, Hanneke JJ, Beeckman D. (2018) An automatic repositioning system to prevent pressure ulcers: a case series *British Journal of Nursing*, 6, 22-27.

Koppelaar E., J.J. Knibbe, H.S. Miedema, A. Burdorf (2013) The influence of individual and organisational factors on nurses' behaviour to use lifting devices in healthcare, *Applied Ergonomics* 44, 532-537. Lee, SJ., Rempel, D. (2020). Comparison of lift use, perceptions, and musculoskeletal symptoms between ceiling lifts and floor-based lifts in patient handling, *Applied Ergonomics* 82, 102954.

Lee, SJ, Rempel D., (2020) Comparison of lift use, perceptions, and musculoskeletal symptoms between ceiling lifts and floor-based lifts in patient handling *Appl Ergon* Jan;82:102954.

Marras W., Knapik G, Ferguson S. (2009). Lumbar spine forces during manoeuvring of ceiling-based and floor-based patient transfer devices. *Ergonomics*, 52, 3: 384- 397.

Picavet HSJ., (2001). Public Health questions on physical disabilities and musculoskeletal conditions, studies using health surveys, Wageningen Universiteit, Wageningen.

Rice M., Woolley S., and Waters T. (2009). Comparison of required operating forces between floor based and overhead mounted patient lifting devices, *Ergonomics*, vol. 52, pp. 112 - 120, 2009.

Senek M., Robertson S, et al (2020). The association between care left undone and temporary Nursing staff ratios in acute settings: a cross-sectional survey of registered nurses, *BMC Health Services Research* volume 20, Article number: 637.

Vieira, ER., Miller L. (2008). Facing the Challenge of Patient Transfers: Using Ceiling Lifts in Healthcare Facilities, *Health Environments Research & Design Journal*, 2, 1, PP 6-16.

Vinstrup J, Jakobsen MD, Madeleine P, Andersen LL, (2020) Physical exposure during patient transfer and risk of back injury & low-back pain: prospective cohort study, *BMC Musculoskeletal Disord*, Oct 31;21(1):715.