PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Predictors of physical activity levels in children and adolescents with cerebral palsy: clinical cohort study protocol
AUTHORS	Fonvig, Christina; Troelsen, Jens; Dunkhase-Heinl, Ulrike; lauritsen, jens; Holsgaard-Larsen, A.

VERSION 1 – REVIEW

REVIEWER	Clanchy, Kelly Griffith University, School of Allied Health Sciences
REVIEW RETURNED	02-Mar-2021

GENERAL COMMENTS	Comment 1: The article details an important protocol to determine the predictors of physical activity participation in adolescence with cerebral palsy. The outcomes of this study can be used to develop models for the promotion of physical activity participation in this important, but under-researched, population. In order to strengthen the importance of this study protocol a stronger understanding of the long-term outcomes of decreased physical activity participation in children and adolescents with cerebral palsy specifically should be established. Comment 2: The use of the ICF model in order to organise for the potential predictors of a physical activity participation is a strength of the study as it moves beyond merely the influence of health conditions/ impairments alone as a predictor of participation. However important personal and environmental factors/ mediators that could influence physical activity participation including self-efficacy, social support, enjoyment, physical access and/or resource access etc have not been included. This should be acknowledged as a limitation of the study. Comment 3: Information regarding the mode of physical activity typically undertaken is an important consideration for programs that aim to promote increased participation. It is not clear from the information included in the article why bike use (including bicycles, tricycles, and running bikes) has been included as a separate variable under activities, with an associated 4-point likert scale, while participation in recreational activities (including swimming, strength training, RaceRunning etc) is included in the participation section with a binary yes/no outcome. Comment 4: Consider the level of detail included in the supplementary questions section. There should be sufficient information to allow the reader to understand how each variable

	will be measured and evaluated. For example, additional information regarding the protocol for the measurement of sleep and/or screen time needs to be provided. For example, is this measured in a daily log over a 7 day period and averaged, or is the individual asked to recall a typical day. How will the variances in weekday versus weekend levels be accounted for? Comment 5: In the additional analysis section a qualitative study is referred to that will explore the daily life challenges that parents face in their pursuit of helping their children the CP live physically active lifestyles. However the methods for how this data will be collected and evaluated are not clearly included in the study protocol. This information is important as family members and other people close to the child/adolescent are likely be very important conduits and advocates for physical activity participation. Comment 6: Some additional detail in the accelerometer analysis section would strengthen the paper. For example, non-wear time is defined as a time in which the accelerometer is not worn e.g., showering. How will this be determined? Will the participant keep a log of their wear time or will an objective criteria be applied e.g., consecutive 0 counts for at least 60 consecutive minutes, allowing for up to 2 consecutive 1-minute epochs with nonzero counts less than or equal to 100 counts? Comment 7: A limitation of the study is the exclusion of children who are classified as GMFCS IV who may walk assisted as a means of ambulation over short distances or participate in active propulsion. Children classified as GMFCS IV are a priority for the promotion of physical activity participation based on their long-term health outcomes.

REVIEWER	Lavelle, Grace King's College London, Institute of Psychiatry
REVIEW RETURNED	17-Mar-2021

GENERAL COMMENTS	Thank you to the authors for proposing this pertinent piece of work to examine the predictors of Physical Activity (PA) levels in children and adolescents with cerebral palsy. This is a well-written and succinct study protocol and the rationale for such work is clear. It is encouraging to see the proposed sample size, which is a strength of this work. This is an important piece of work and I look forward to the interesting findings it will generate regarding the predictors of habitual PA in children and adolescents, and future conclusions on how this could be incorporated into clinical practice. Please find specific comments I suggest are addressed as follows: • A clear and appropriate description of proposed accelerometry measurement of habitual PA is presented. It is also welcome that the authors have proposed using cut-points for accelerometry which have been specifically validated for people with CP across different gross motor function levels (Trost et al., 2013). Provide further justification that 8 hours wear time should be between 6am

and 10pm. Is wear time outside of these hours going to be excluded?

- In addition to diaries will automatic measures of non-wear time e.g. (60 consecutive 0s) be used to remove data? "The GGIR default setting for non-wear time will be utilized"- can the authors please specify what this is please? Important to define this and for the authors to consider how to handle data if diaries are not returned.
- Can the authors clarify the inclusion criteria of 8-15 years. For example, if a participant was 15 at the time of the CPUP assessment but 24 months has elapsed since, will they be invited to take part?
- It is particularly interesting to see sleep, screen-time, and socio-economic status included in your proposed list of potential predictors. Pg. 3 line 53 the authors states that socio-economic status will be captured. Can the authors please clarify what measure is being used for this please?
- The authors state that “supplementary questions regarding sleep, screen time, self-reported range of motion in the lower extremities, means of transportation to and from school, and assessment of mobility through the Functional Mobility Scale will be collected”. The collection of this data could be strengthened by use of validated questionnaires where possible, for example sleep, screen-time etc. If this is not possible perhaps this can be added to the limitations.
- Could the authors provide more detail on how self-reported range of motion in the lower extremities will be assessed by the parent/guardian please? Table 1 details than an illustration will be used for "more" or "less". Can the authors expand please and provide justification for using this self-report when also captured via CPUP measured variables. Presumably this is due to the fact that up to 38 months may have elapsed. This should be acknowledged as a major limitation in findings if ROM from the CPUP is considered a main predictive variable.
- It may also be pertinent to ask if the child/young person has undergone any lower limb surgery etc. between the timepoint of CPUP data collection point and the collection of PA. If this is not possible perhaps this can be added to the limitations.
- Please replace "ANKEL with ANKLE in Table 1 (Page 15) also.
- There is a lack of clarity surrounding the description of some of the measures used as part of the CPUP variables in Table 1 e.g. “Pain” – Y/N. As this is subjective could this be repeated during the questionnaire to avoid the response time lag? The same may be applicable for “ability to climb stairs” and “bikes”, “residence region”, “Use of orthosis”, “wheelchair use” – presuming that these were subjective self-reports? If this is not possible perhaps this can be added to the limitations.
- Table 1. Page 17 It is suggested to replace sex with “Male/Female” rather than “Boy/Girl”
- Additional analyses - It is encouraging to also see the future planned work for this group, especially the planned qualitative study. Can the authors confirm that this will be separate to this work and therefore further detail re study protocols will be described elsewhere as appropriate?
- Page 20 line 27: Correct though to through.

	• It is encouraging to see that PPI groups have been engaged with regarding the acceptability of the measures and that feedback has been acted upon and incorporated to improve the participant experience. Can the authors confirm if the national interest group will receive the final study documentation or will be involved in an active, ongoing process i.e. consultations on the content design, dissemination plan etc. as this may improve the reach of these important findings. • The authors state in the discussion that “the present study will provide novel evidence for how to optimise PA for children and adolescents”. I think it may be more accurate to state that it may provide evidence of the predictors instead, as your study design does not address how to optimise PA but instead for whom we may need to do so in particular for. I am also unsure if it correct to state that these results “provide health professionals with a clinical tool” but more likely to inform more targeted interventions to increase PA rather than a specific clinical tool. Also, as your limitations section states causality cannot be determined, and so caution is warranted. • Limitations: Due to the retrospective nature of some of this work it is clear that some of the limitations of this work are inherent due to the study design. However, I suggest that the following are also highlighted as limitations to the interpretation of the results: 1. Parental proxy-reports are being used and therefore measures are not capturing the perspective of people with CP but their carers/parents. While this has been acknowledged in the limitations section of the articles due to the “diverse cognitive abilities in the target group” is it possible to evidence this? Also, I feel that this needs to be clear throughout the narrative of the protocol that it is proxy-measured outcomes. 2. There is an obvious time-lag between variables collected via CPUP and parental proxy measures. The authors have stated that retrospective data "has been collected within the 38 months prior to the assessment of PA levels”. 8-15 are formative years and physical changes etc. for an adolescent over a 3-year period can be monumental (e.g. Height/Weight). It is encouraging to see that this is acknowledged in the analysis plan as follows “To evaluate the significance of CPUP data collection periods relative to the time in months from the measure of PA, the model will test for differences in prediction analyses between the following time periods: 0 ≤ 12 months, 13 ≤ 24 months, and 25+ months (Figure 2).” However, I think that this limitation needs further expansion in the limitations section 3. This work is limited to those presenting as GMFCS levels I-III and therefore results will not be applicable for those > Level III GMFCS.

	4. It have been acknowledged that only one accelerometer rather than two does limit the possibility of differentiating activity. While the practical justification for this is fully understood and very reasonable to increase compliance, it may also be worth noting that hip worn accelerometry also excludes capturing upper-limb activity and water-based activity (e.g. swimming), which is often the choice of sport for people with CP and therefore there may be an underestimation of PA levels.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Dr. Kelly Clanchy, Griffith University

Comment 1: The article details an important protocol to determine the predictors of physical activity participation in adolescence with cerebral palsy. The outcomes of this study can be used to develop models for the promotion of physical activity participation in this important, but under-researched, population. In order to strengthen the importance of this study protocol a stronger understanding of the long-term outcomes of decreased physical activity participation in children and adolescents with cerebral palsy specifically should be established.

Author response: Thank you for your comment. Despite not being investigated in the current study, we agree that it is important to stress the possible long-term/persistent consequences of decreased physical activity. Together with the initial text, we have added the following in the introduction:

Author action: (page 5, line 1-4): Furthermore, evidence suggests that more than 25% of adults with CP experience mobility decline, for some resulting in persistent loss of independent gait function, thus, emphasizing the importance of maintaining a physical active lifestyle throughout childhood and adolescence(11).

Comment 2: The use of the ICF model in order to organize for the potential predictors of a physical activity participation is a strength of the study as it moves beyond merely the influence of health conditions/ impairments alone as a predictor of participation. However important personal and environmental factors/ mediators that could influence physical activity participation including self-efficacy, social support, enjoyment, physical access and/or resource access etc have not been included. This should be acknowledged as a limitation of the study.

Author response: Thank you for your comment. To acknowledge the many facets of environmental factors/mediators we have revised the text.

Author action: The following text has been added to the limitations section (page 22, line 9-11): Although the study aims to cover a broad aspect of ICF components, important personal and environmental factors such as self-efficacy, social support, motivation, and physical access are not included in the analysis.

Comment 3: Information regarding the mode of physical activity typically undertaken is an important consideration for programs that aim to promote increased participation. It is not clear from the information included in the article why bike use (including bicycles, tricycles, and running bikes) has been included as a separate variable under activities, with an associated 4-point likert scale, while participation in recreational activities (including swimming, strength training, RaceRunning etc) is included in the participation section with a binary yes/no outcome.

Author response: The outcome type for variables in the CPUP database is predetermined, thus the variable
'bike use' has a 4-point likert scale. The CPUP database is customized to the Northern countries where biking is a common means of transport for adults and children alike, which could explain the reasoning behind the outcome type.
Participation in recreational activities is included as a dichotomous (Yes/No) variable from the CPUP database. The database does include the possibility to fill out which recreational activities the child participates in, however, the completeness of this variable is questionable. Therefore, we have added this question again in the costume-made questionnaire sent to the parents so that we may get a better understanding of which recreational activities the child participates in.

Comment 4: Consider the level of detail included in the supplementary questions section. There should be sufficient information to allow the reader to understand how each variable will be measured and evaluated. For example, additional information regarding the protocol for the measurement of sleep and/or screen time needs to be provided. For example, is this measured in a daily log over a 7 day period and averaged, or is the individual asked to recall a typical day. How will the variances in weekday versus weekend levels be accounted for?

Author response: Thank you for pointing out the need for more information in the description of "Supplementary questions". The section has been re-written:

Author action: (page 12, line 13-21): The following assessment will be evaluated by means of a supplementary parent-reported questionnaire: The child's average sleep and screen time on a typical weekday and weekend-day, and parent's socio-economic status as determined by the parent (based on questionnaires used in the PHASER study)(34). Visual evaluation of range of motion for the joint on the most affected side; the parent is shown a picture of a joint movement (positioned in the minimum range of motion considered acceptable according to the CPUP's physiotherapy protocol) (35), and is asked to evaluate whether the child's joint is capable of 'more' or 'less' movement than the depicted picture (see Appendix – Parent-evaluated range of motion in the lower extremity). Furthermore, assessment of mobility through the Functional Mobility Scale (FMS)(33) (for more detail see Table 1).

Comment 5: In the additional analysis section a qualitative study is referred to that will explore the daily life challenges that parents face in their pursuit of helping their children the CP live physically active lifestyles. However the methods for how this data will be collected and evaluated are not clearly included in the study protocol. This information is important as family members and other people close to the child/adolescent are likely be very important conduits and advocates for physical activity participation.

Author response: We agree that the qualitative study will contribute with important information regarding environmental and personal factors that undoubtedly play a role in the child's physical activity participation. However, the qualitative study is not a part of this quantitative study protocol, solely outlining the primary analyses, and thus the methods and findings of the qualitative study will be reported elsewhere.

Author action: The following has been added in the "Additional analyses" text: (page 19, line 17): The methods and findings of this study will be reported elsewhere.
Comment 6: Some additional detail in the accelerometer analysis section would strengthen the paper. For

example, non-wear time is defined as a time in which the accelerometer is not worn e.g., showering. How will this be determined? Will the participant keep a log of their wear time or will an objective criteria be applied e.g., consecutive 0 counts for at least 60 consecutive minutes, allowing for up to 2 consecutive 1-minute epochs with nonzero counts less than or equal to 100 counts?

Author response: Thank you for your comment. We have since the initial submission of the manuscript been made aware of some minor complications with the GGIR software relating to non-wear-time, thus we have decided to refrain from using this software. Now, as described in details below and in the revised manuscript, data will be processed using costume made Matlab script (Rasmussen et al. 2020), and nonwear-time will be handled as described in the text below. Furthermore, we have eliminated the use of diaries, as the non-wear algorithm will determine non-wear time objectively and more precisely than parent-reported diaries. Additionally, this will mean that the parents and the child are less burdened, as they do not have to remember to write specific times down every time the belt is taken off.

Author action: The following text has been altered in the manuscript (page 9, line 22 – page 10, line 9):
According to procedures used in previous studies(24) the non-wear periods are identified and registered as missing data by evaluating three signal features generated from acceleration in combination with temperature and predefined expected awake time. Periods of no movement (acceleration below 20 mg) will
be identified as non-wear depending on the timespan; 1) periods longer than 120 min will always be identified as non-wear, 2) periods from 45 to 120 min are identified as non-wear if the average temperature is below an individually estimated non-moving temperature (NMT) threshold, 3) periods of 10 to 45 min with no movement are only identified as non-wear if the average temperature is below the NMT threshold and if the end of the period is within the expected awake time. Device transportation (registration of movement when the device is not worn by the child) is identified as non-wear if the average temperature of the period is below the NMT threshold(24).
(page 10, line 12-13) Total wear time and activity counts will be processed using Matlab (Mathworks Inc., Natick, Massachusetts, US).

Comment 7: A limitation of the study is the exclusion of children who are classified as GMFCS IV who may walk assisted as a means of ambulation overshort distances or participate in active propulsion. Children classified as GMFCS IV are a priority for the promotion of physical activity participation based on their longterm health outcomes.

Author response: We acknowledge the exclusion of children at GMFCS level IV as a limitation of the study, and we are aware that level IV-V children ought to be a priority. However, the use of accelerometers as a means of evaluating physical activity is not validated for wheelchair use. The following text has been added to the limitations section:

Author action (page 22, line 12-18): While children at GMFCS IV may walk assisted as a means of ambulation over short distances, or participate in active propulsion, neither level IV or V are included in this study as the use of wheelchairs complicate valid measurement of physical activity using accelerometer.
Consequently, results of this study will not be applicable to children at a GMFCS level IV-V and thus hinders external validity.

Reviewer: 2
Dr. Grace Lavelle, King's College London

Please find specific comments I suggest are addressed as follows:

- A clear and appropriate description of proposed accelerometry measurement of habitual PA is presented. It is also welcome that the authors have proposed using cut-points for accelerometry which have been specifically validated for people with CP across different gross motor function levels (Trost et al., 2013). Provide further justification that 8 hours wear time should be between 6am and 10pm. Is wear time outside of these hours going to be excluded?

Author response: Thank you for your comment. Yes, wear time outside of this timeframe will not be included in the analysis. A valid wear day is defined as a day where the accelerometer is worn for at least 10 hours out of the expected predefined awake hours (between 6 a.m. and 10 p.m. on week days and 7. a.m. and 11.59 p.m. on weekend days). For the age group of the participants (8-15 years), it is reasonable to assume that their active hours are within this timeframe. The children are encouraged to wear the belt all day, including while sleeping, to enhance wear compliance.

Author action: The following sentence has been altered to clarify the wear timeframe (page 9, line 17-21): A valid wear day will be defined as a day where the accelerometer is worn for at least 10 hours out of the expected awake time (defined as hours between 6 a.m. and 10 p.m. on week days, and 7. a.m. and 11.59 p.m. on weekend days. A similar method has been used in the study by Rasmussen et al. (2020) to assess non-sedentary time with screen time use (24).

- In addition to diaries will automatic measures of non-wear time e.g. (60 consecutive 0s) be used to remove data? "The GGIR default setting for non-wear time will be utilized"- can the authors please specify what this is please? Important to define this and for the authors to consider how to handle data if diaries are not returned.

Author response: Thank you for your comment. We have since the initial submission of the manuscript been made aware of some minor complications with the GGIR software relating to non-wear-time, thus we have decided to refrain from using this software. Now, as described in details below and in the revised manuscript, data will be processed using Matlab as in the study by Rasmussen et al. (2020), and non-weartime will be handled as described in the following text:

Author action: The following text has been altered in the manuscript (page 9, line 22 – page 10, line 12): According to procedures used in previous studies(24) non-wear periods are identified and registered as missing data by evaluating three signal features generated from acceleration in combination with temperature and predefined expected awake time. Periods of no movement (acceleration below 20 mg) will be identified as non-wear depending on the timespan; 1) periods longer than 120 min will always be identified as non-wear, 2) periods from 45 to 120 min are identified as non-wear if the average temperature is below an individually estimated non-moving temperature (NMT) threshold, 3) periods of 10 to 45 min with no movement are only identified as non-wear if the average temperature is below the NMT threshold and if the end of the period is within the expected awake time. Device transportation (registration of movement when the device is not worn by the child) is identified as non-wear if the average temperature of the period is below the NMT threshold(24). Non-valid data will be excluded for further analysis.

Total wear time and activity counts will be processed using Matlab (Mathworks Inc., Natick, Massachusetts, US).

- Can the authors clarify the inclusion criteria of 8-15 years. For example, if a participant was 15 at the time of the CPUP assessment but 24 months has elapsed since, will they be invited to take part?

Author response: Thank you for your comment on inclusion criteria. We would like to invite children and adolescents around the ages of 8-15 years to participate, as this is a biological age where gait and mobility are matured. To clarify the age criteria, we have added the exact date of birth and the date of study enrollment.

Author response: the following change has been made to the text (page 7, line 16-18): To increase the external validity and sample size of the present project, the inclusion criteria will include children and adolescents of 8-15 years (born between 01.01.2003 - 31.12.2013) who are diagnosed with CP. Inclusion via invitation commenced November 3rd 2020.

- It is particularly interesting to see sleep, screen-time, and socio-economic status included in your proposed list of potential predictors. Pg. 3 line 53 the authors states that socio-economic status will be captured. Can the authors please clarify what measure is being used for this please?

Author response: The measures being use to capture socio-economic status, is part of the costume-made parent-reported questionnaire where the parent is asked to report the highest level of education in the household on a 10-point likert scale (Table 1) as well as their job situation. The questionnaire has previously been used in the PHASER study (Pedersen et al (2018)), where physical activity was assessed in more than 2000 typically developed children in Denmark, thus allowing for comparability.

Author action: The following changes have been made to clarify the measures (page 12, line 13-16): The following assessment will be evaluated by means of a supplementary parent-reported questionnaire: The child’s average sleep and screen time on a typical weekday and weekend-day, and parent’s socio-economic status as determined by the parent (based on questionnaires used in the PHASER study(34).

- The authors state that “supplementary questions regarding sleep, screen time, self-reported range of motion in the lower extremities, means of transportation to and from school, and assessment of mobility through the Functional Mobility Scale will be collected”. The collection of this data could be strengthened by use of validated questionnaires where possible, for example sleep, screen-time etc. If this is not possible perhaps this can be added to the limitations.

Author response: Thank you bringing this to our attention. We agree that it would strengthen the study had screen time and sleep been assessed through validated questionnaires. However, we choose to make use of questionnaires implemented in the PHASER study (Pedersen et al. 2018) allowing for direct comparability with typically developed children and adolescents in Denmark. However, it is correct that this should be mentioned in the limitations:

Author action: The following has been added to the limitations section (page 22, line 1-4): To allow for comparability, data on sleep time, screen time and socio-economic status were assessed using a questionnaire developed for assessment of typically developed children and adolescents in Denmark (34). Data could have been strengthened by the use of validated questionnaires.

- Could the authors provide more detail on how self-reported range of motion in the lower extremities will be assessed by the parent/guardian please? Table 1 details than an illustration will be used for "more" or "less". Can the authors expand please and provide justification for using this self-report when also captured via CPUP measured variables. Presumably this is due to the fact that up to 38 months may have elapsed. This should be acknowledged as a major limitation in findings if ROM from the CPUP is considered a main predictive variable.

Author response: Thank you for your comment on ROM. The parent-reported range of motion evaluations using visual illustrations (now described in a new appendix), is justified as a simple tool, performed by the parent, to evaluate range of motion as 'more' or 'less' than what is considered an acceptable range of motion by the CPUP. The self-reported assessments are not intended to replace the CPUP values, by rather to assess whether parent-reported range of motion is an operational method of assessment.

Author action: the following text has been altered in the manuscript: (page 12, line 16-20): Visual evaluation of range of motion for the joint on the most affected side; the parent is shown a picture of a joint movement (positioned in the minimum range of motion considered acceptable according to the CPUP's physiotherapy protocol) (35), and is asked to evaluate whether the child's joint is capable of 'more' or 'less' movement than the depicted picture (see Appendix – Parent-evaluated range of motion in the lower extremity).

- It may also be pertinent to ask if the child/young person has undergone any lower limb surgery etc. between the timepoint of CPUP data collection point and the collection of PA. If this is not possible perhaps this can be added to the limitations.

Author response: Thank you for this comment. We strongly agree that lower limb surgery is very relevant information in this setup. As noted on page 13, line 2-4, relevant hospital operations and procedures for the children/adolescents will be collected through the Danish National Patient Register.

- Please replace "ANKEL with ANKLE in Table 1 (Page 15) also.

Author action: Thank you for pointing this out. The corrections have been made.

- There is a lack of clarity surrounding the description of some of the measures used as part of the CPUP variables in Table 1 e.g. "Pain" – Y/N. As this is subjective could this be repeated during the questionnaire to avoid the response time lag? The same may be applicable for "ability to climb stairs" and "bikes", "residence region", "Use of orthosis", "wheelchair use" – presuming that these were subjective self-reports? If this is not possible perhaps this can be added to the limitations.

Author response: Thank you for bringing this to our attention. It is correct, that the CPUP data is self-/parent-reported subjective data. It is not possible to repeat the questions in the costume-made questionnaire, as it has already sent to the families (commences November 3rd 2020). However, although we have some variables that are repeated (e.g. the Functional Mobility Score, GMFCS level, participation in recreational activities), we did not wish to burden the families with having to go through the exact same

lengthy questionnaires that they do yearly at CPUP follow-ups. Furthermore, we have included the PODCI and the PedsQL questionnaire, as we believe these validated questionnaires will provide the study with additional valuable data on the children otherwise not accessible.

- Table 1. Page 17 It is suggested to replace sex with "Male/Female" rather than "Boy/Girl"

Author response: Thank you for pointing this out.

Author action: (Table 1) The text has been replaced as suggested.

- Additional analyses - It is encouraging to also see the future planned work for this group, especially the planned qualitative study. Can the authors confirm that this will be separate to this work and therefore further detail re study protocols will be described elsewhere as appropriate?

Author response: Thank you for your comment. It is correct that the methods and findings of the qualitative study will be reported elsewhere.

Author action: the following text has been added to the "Additional analyses" section (page 19, line 17): The methods and findings of this study will be reported elsewhere.

- Page 20 line 27: Correct though to through.

Author response: Thank you for pointing this out.
Author action: (page 20, line 10): The text has been corrected as suggested.

- It is encouraging to see that PPI groups have been engaged with regarding the acceptability of the measures and that feedback has been acted upon and incorporated to improve the participant experience. Can the authors confirm if the national interest group will receive the final study documentation or will be involved in an active, ongoing process i.e. consultations on the content design, dissemination plan etc. as this may improve the reach of these important findings.

Author response: Thank you for bringing up this important point. We can in fact confirm that national interest groups are involved in the ongoing process, and that it is our full intention to consult our study findings with PPI groups to ensure relevance and to disseminate our findings. In fact, the first author is a board member of CPUP's database steering committee and will thus easily mediate knowledge from the research project to relevant clinical groups.

- The authors state in the discussion that "the present study will provide novel evidence for how to optimise PA for children and adolescents". I think it may be more accurate to state that it may provide evidence of the predictors instead, as your study design does not address how to optimise PA but instead for whom we may need to do so in particular for. I am also unsure if it correct to state that these results "provide health professionals with a clinical tool" but more likely to inform more targeted interventions to increase PA rather than a specific clinical tool. Also, as your limitations section states causality cannot be determined, and so caution is warranted.

Author response and action: Thank you for your relevant comment. We acknowledge that it is more correct stating, that the results of the study will provide evidence of the predictors for PA, rather than on how to optimize PA. The following changes have been made in the discussion section (page 20, line 14-15): The present study will provide novel evidence of predictors of PA for children and adolescents with CP.
Furthermore, we have rephrased the clinical impact of evidence-based PA guidelines: (page 21, line 1-4): The study findings may be implemented in evidence-based PA guidelines, which are currently lacking for children with cerebral palsy, thus providing health professionals with a clinical instrument to help increase PA levels in children and adolescents with cerebral palsy.

Limitations:
Due to the retrospective nature of some of this work it is clear that some of the limitations of this work are inherent due to the study design. However, I suggest that the following are also highlighted as limitations to the interpretation of the results:

1. Parental proxy-reports are being used and therefore measures are not capturing the perspective of people with CP but their carers/parents. While this has been acknowledged in the limitations section of the articles due to the "diverse cognitive abilities in the target group" is it possible to evidence this? Also, I feel that this needs to be clear throughout the narrative of the protocol that it is proxy-measured outcomes.

Author response: Thank you for your comment. As previously stated, there is evidence to support that children above the age of five are capable of self-reporting QoL independently. Futhermore, Hägglund et al (2020) reported in their population-based registry study on 3783 children, that the proportion of reported pain was almost equal between self and proxy-reporting. However, as we have invited all children with CP in Denmark (born between 01.01.2003 - 31.12.2013), we know that there are children who are cognitively affected as a result of their CP, and therefor are not capable of independently reporting a lengthy questionnaire (estimated to take 30-60 minutes to fill out the questionnaire).

Based on this knowledge, we made the decision to only include proxy-reported questionnaires ensuring comparable methodology. However, to clarify the use of proxy-reported measures and to acknowledge associated limitations, already in the Methods section, we have added the following sentence.

Author action: Methods section (page 12, line 22-23): All data from the PedsQL, PODCI and supplementary questionnaires are proxy-reported by a parent or caregiver.

2. There is an obvious time-lag between variables collected via CPUP and parental proxy measures. The authors have stated that retrospective data "has been collected within the 38 months prior to the assessment of PA levels”. 8-15 are formative years and physical changes etc. for an adolescent over a 3-year period can be monumental (e.g. Height/Weight). It is encouraging to see that this is acknowledged in the analysis plan as follows “To evaluate the significance of CPUP data collection periods relative to the time in months from the measure of PA, the model will test for differences in prediction analyses between the following time periods: 0 ≤ 12 months, 13 ≤ 24 months, and 25+ months (Figure 2).” However, I think that this limitation needs further expansion in the limitations section

response: Thank you for your comment of this matter. We agree that the spread in time span between CPUP data and additional collected data is a limitation, especially since the participants are developing children. We have added the following text to the limitation section:

Author action (p.21, line 19-22): A possible 0-38 month time lag between variables collected via CPUP and the accelerometer data is a methodology limitation. As the participants are at a developmental age where physical change can be monumental, sensitivity analysis will be performed to evaluate the potential significance of the time lag.

. This work is limited to those presenting as GMFCS levels I-III and therefore results will not be applicable for those > Level III GMFCS.

Author response: Thank you. We will adjust the text to be more specific regarding this limitation:

Author action: (page 22, line 14-18): While children at GMFCS IV may walk assisted as a means of ambulation over short distances or participate in active propulsion, neither level IV or V children are included in this study as the use of wheelchairs complicate valid measurement of physical activity using accelerometer. Consequently, results of this study will not be applicable to children at a GMFCS level IV-V and thus hinders external validity.

4. It have been acknowledged that only one accelerometer rather than two does limit the possibility of differentiating activity. While the practical justification for this is fully understood and very reasonable to increase compliance, it may also be worth noting that hip worn accelerometry also excludes capturing upper-limb activity and water-based activity (e.g. swimming), which is often the choice of sport for people with CP and therefore there may be an underestimation of PA levels.

Author response: Thank you for your comment on this subject. The study does not seek to differentiate the type of physical activity; however, the use of only a hip-worn accelerometer does exclude the registration of upper-body activities, which is a limitation. The following text has been added to the limitation section:

Author action: (page 23, line 2-3): Furthermore, a hip worn accelerometer may exclude capturing upper-limb activities, possibly resulting in an underestimation of physical activity levels.

Reviewer: 1
Competing interests of Reviewer: None declared
Reviewer: 2
Competing interests of Reviewer: None declared