,3& DGDSWpH GH VHPDLQHV FRQoXH VSpFL¿TXHPHQW SRXU OHV DGROHVFHQWHV prédéterminés ont été établis pour évaluer la faisabilité, la validité et l'acceptabilité du modèle d'étude. Les données évaluant les changements touchant la qualité de vie, la dépression, l'anxiété, la perception de la douleur, la détresse psychologique et le cortisol salivaire ont été recueillies durant la période de 4 mois de l'étude. Résultats: Dix-neuf participantes ont participé à l'étude et leur âge moyen était de 15,8 ans (écart de 13,9 à 17,8). Le taux d'attrition était faible (17 %). L'assistance aux séances de pleine conscience (84 %) et l'observance du protocole de l'étude (100 %) étaient élevées. Toutes les participantes ont déclaré un changement positif de la façon dont elles traitaient avec la douleur. Aucun changement n'a été détecté en ce qui concerne la qualité de vie, la dépression, l'anxiété, la perception de la douleur, HW OD GpWUHVVH SV\FKRORJLTXH 'HV UpGXFWLRQV VLJQL¿FDWLYHV GHV WDX[G SOHLQH FRQVFLHQFH RQW pWp REVHUYpHV Conclusions: La pleine conscience est une approche thérapeutique SURPHWWHXVH SRXU ODTXHOOH LO Q¶H[LVWH TXH GHV GRQQpHV OLPLWpHV SRXU Notre étude indique la faisabilité de mener ces interventions auprès d'adolescentes. Il faut un vaste essai pour démontrer O¶HˆFDFLWp HW OHV H‡HWV ELRSK\VLRORJLTXHV GHV ,3& FKH] OHV DGROHVFHQW

Mots clés: pleine conscience, adolescente, douleur chronique, faisabilité, randomisé, pilote

Author contributions

NC conceptualized and coordinated the study, performed data analysis, and drafted the initial manuscript. AM contributed to the design of the study, revised the protocol, taught and adapted the mindfulness-based intervention. MV and CMH revised the protocol. AD conducted cortisol analyses. PLD provided supervision and revised the mindfulness-based intervention. TML and JL revised the protocol and contributed to data analysis. NH revised the protocol and contributed to data collection. All authors contributed to data interpretation and revision of the manuscript.

Abbreviations

CBT	Cognitive Behavioral Therapy
MBI	Mindfulness Based Intervention
MBCT	Mindfulness Based Cognitive Therapy
MBSR	Mindfulness Based Stress Reduction

,QWURGXFWLRQ

Chronic pain in adolescents is a common condition, UHVXOWLQJ LQ VLJQL¿FDQW LPSDFWV RQ GHYHORSPHQW DQG OHYHO RI IXQFWLRQLQJ $OWKRXJK GH¿QLWLRQV YDU\ ZLGHO\ D review article on this topic suggests that: "[chronic pain] is overwhelmingly prevalent in children and adolescents and should be recognized as a major health concern" (King et al., 2011). The high emotional burden associated with chronic pain translates into a reduction in health-related quality of OLIH :DUVFKEXUJHU HW DO interventions promoting the acquisition and strengthening RI DSSURSULDWH FRSLQJ VWUDWHJLHV FRXOG UHVXOW LQ EHQH¿WV IRU this group of adolescents for whom pain is often long-lasting and disabling (Kashikar-Zuck et al., 2013).

There has been a growing interest in the study of mindfulness-based interventions (MBIs) in children, adolescents and adults with various physical and mental health conGLWLRQV LQFOXGLQJ FKURQLF SDLQ *RWLQN HW DO 6D ders, 2015). Drawing from meditation practices rooted in a number of Buddhist traditions, most contemporary forms of mindfulness meditation that are studied in the setting of clinical research seek to promote purposeful and non-judgemental awareness of one's thoughts, feelings and sensations (Kabat-Zinn, 1991). Since the early 1980s, when it ZDV ¿UVW VWXGLHG FOLQLFDOO\ LQ JURX tory pain conditions (Kabat-Zinn, 1982), mindfulness has been taught through various structured and semi-structured programs to both clinical and non-clinical populations of children, adolescents and adults. Among the numerous and increasing number of available programs, the most widely studied interventions adopt a similar eight-week structure. These interventions include formal meditation practices, mindful movement and breathing as well as informal practices that can be integrated in daily life activities (Fjorback, $UHQGW 2UQEROO)LQN :DODFK

(YLGHQFH ORRNLQJ DW WKH EHQH¿WV RI populations with chronic pain is increasing (Bawa et al., /DNKDQ 6FKR¿HOG $ UHFHQW controlled trial conducted in adults suggested that mindIXOQHVV KDV VLJQL¿FDQW ORQJ ODVWLQJ RI WKH H[SHULHQFH RI SDLQ LQFOXGLQJ LHW\ GHSUHVVLRQ DQG SV\FKRORJLFDO Z 3HWWHUVHQ $QRWKHU VWXG\ D FRPSDU a MBI and cognitive behavioural therapy (CBT) for adults with somatoform disorders found that the MBI, derived from a well-studied mindfulness curriculum for adults, was comparable to CBT, with more rapid improvements for patients in the MBI group (Fjorback et al., 2013). The safety of conducting MBIs in clinical populations is still being studied at this time, but many authors have suggested that MBIs are safe, provided that adequate psychological support is available (Compson, 2014). A number of studies KDYH H[SORUHG WKH ELRORJLFDO HuHFWV the use of markers such as salivary cortisol (Matousek, 'RENLQ 3UXHVVQHU 6R IDU UHGX levels have been shown in some studies, but results in randomized-controlled trials have been inconsistent (O'Leary, 2¶1HLOO 'RFNUD\

W KDV EHHQ VXJJHVWHG WKDW

The body of evidence concerning MBIs in adolescents is less abundant than in the adult literature, but work in the DUHD LV HPHUJLQJ 0DOERHXI +XUWXELVH $FKLOOH 6XOWDQ Vadnais, 2014). Recent studies pertaining to a broad range of MBIs in youth indicate that mindfulness is a promis- LQJ DGMXQFW WUHDWPHQW IRU FKURQLF SDLQ FRQGLWLRQV DQ[LHW\ DQG GHSUHVVLRQ 6LPNLQ %ODFN VXOWV DUH HQFRXUDJLQJ LW UHPDLQV GLvFXOW WR FRQFOXGH RQ WKH PDJQLWXGH RI WKH HuHFWV RI 0%,V LQ \RXWK GXH WR WKH important heterogeneity of research methods used (Tan, 6LPLODUO\ ¿QGLQJV RQ ELRORJLFDO FRUUHODWHV VXFK DV changes in salivary cortisol levels are promising, but lack reproducibility and large-scale validation (Schonert-Reichl HW DO 6LELQJD HW DO

:LWK UHJDUG VSHFL¿FDOO\ WR DGROHVFHQWV ZLWK FKURQLF SDLQ data remains limited. To our knowledge, no large-scale randomized study has been conducted so far. A small pilot study (n=6) evaluating a MBI in youth with chronic pain UHSRUWHG QXPHURXV GLvFXOWLHV SHUWDLQLQJ WR UHFUXLWPHQW DQG retention such that authors were unable to report any quantitative data (Jastrowski Mano et al., 2013).

*LYHQ WKH SDXFLW\ RI HYLGHQFH IRU WKH VWXG\ RI 0%,V LQ adolescents, we undertook a pilot trial to estimate the feasibility, acceptability and validity of a study looking at the HvFDF\ RI DQ DGDSWHG 0%, LQ WHHQDJHUV ZLWK FKURQLF SDLQ :H DOVR FROOHFWHG SLORW GDWD WR DVVHVV ZKHWKHU WKH 0%, LP- SURYHG TXDOLW\ RI OLIH GHSUHVVLYH DQ[LHW\ SDLQ SHUFHSWLRQ psychological distress and salivary cortisol levels among SDUWLFLSDQWV :H K\SRWKHVL]HG WKDW be safe and well tolerated.

Methods

This study was approved by the Institutional Review Board RI 6DLQWH-XVWLQH +RVSLWDO :ULWWHQ from all participants and their parents. Potential advantages and disadvantages related to participation in the study were discussed with every participant during the recruitment interview. <HW DOWKRXJK UH-

Trial design

:H UHSRUW LQ WKLV SDSHU WKH SLORW W the feasibility of conducting a large randomized controlled trial. Figure 1 depicts the timeline of the trial. Participants ZHUH UDQGRPO\ DOORFDWHG WR DQ H[SHU list control group, which subsequently received the eight-week adapted MBI designed for the project. The study was single-blind (to investigator only). During the course of the study, any treatment prescribed by the primary health care provider was maintained.

Participants

The pilot trial was conducted at Sainte-Justine Hospital, a SHGLDWULF WHUWLDU\ FDUH XQLYHUVLW in Montreal, Canada. Participants were referred from seven GLuHUHQW RXWSDWLHQW FOLQLFV DGRO pediatrics, adolescent psychiatry, pain clinic, gastroenterology, neurology and rheumatology. Patients between the ages of thirteen and eighteen who were followed by a physician for a condition resulting in chronic pain of at least three months duration were considered eligible for recruitment if their home was located less than a one-hour drive from the KRVSLWDO DQG LI [illegible]

ideation unknown to the referral physician and intellectual limitation that could hinder study participation.

Patient screening and referral for recruitment were done by DWWHQGLQJ SK\VLFLDQV LQ WKH VHYHQ RXWSDWLHQW FOLQLFV (OLJLEOH participants and their parents met with a recruiting physician (NC and NH) for a 30-minute encounter. During the encounter, the recruiting physician re-evaluated eligibility FULWHULD H[SODLQHG WKH VWXG\ SURJUDP DQG FRPPLWPHQW DQG obtained consent from both the participant and her parent. Baseline data was collected after written consent was obtained from participants and parents. Recruitment was closed once a pre-determined convenient target sample size of 20 participants was reached.

Randomization and intervention

Randomization was done using a computer-generated randomization list and permuted block design, with block sizes RI WZR RU IRXU 3DUWLFLSDQW-V ZHUH DVVLJQHG WR WKH H[SHUL PHQWDO RU WKH ZDLW OLVW FRQWURO JURXS XVLQJ D UDWLR

The MBI consisted of eight consecutive weekly group FODVVHV WDXJKW E\ WZR SV\FKLDWU\ UHVLGHQWV $0 DQG (30 with advanced mindfulness training and personal practice.

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TXHVWLRQQDLUH ZLWK /LNHUW VFDOHV WKH 3HGLDWULF 4XDOLW\ RI /LIH 6FDOH 3HGV4/ GHVLJQHG IRU DGROHVFHQWV DJHV \HDUV &URQEDFK¶V DOSKD 9DUQL %XUZLQNOH Seid, 2006).

Salivary cortisol was collected using Salivette® sampling devices, which consist of a plastic sampling vessel with a suspended insert containing a sterile neutral cotton wool VZDE 9RJHVHU ’XUQHU 6HOLJHU $XHUQKDPPHU Participants were questioned for oral bleeding or ulcers and were asked not to ingest any liquid or solid substances one hour prior to sampling. Swabs were placed under the tongue for 2.5 minutes and immediately returned to the insert. All samples were kept frozen until analysis at the end of the study period. Salivary cortisol was measured using LPPXQRDVVD\ 5RFKH GLDJQRVWLFV &REDV ( )XQFWLRQ-DO VHQVLWLYLW\ ZDV HYDOXDWHG DQG HVWDEOLVKHG DW QPRO / YDULDELOLW\ FRHvFLHQW :LWKLQ UXQ YDULDELOLW\ RI WKH PHWKRG ZDV DOVR YHUL¿HG YDULDELOLW\ FRHvFLHQW Finally, the method was validated by mass spectrometry analysis of eight selected participant specimens including the ORZHVW VDOLYDU\ FRUWLVRO YDOXH QPRO / /LQHDU UHJUHV-VLRQ DQDO\VLV VKRZHG D KLJK $2 FRHvFLHQW RI GHWHUPLQDWLRQ U = 0.87).

Data management

&RKHQ¶V G S YDOXH ference was found in 17:30 cortisol levels at week one vs ZHHN HLJKW 7KHUH ZDV DOVR QR magnitude of the decrease at week one vs week eight.

L PSURYHPHQW participants reported a small positive improvement. Nearly YHU\ OLNHO\ WR UHFRPPHQG WKH SU

Satisfaction with the program and adherence:

Although participants were encouraged to keep a personal ORJ IRU LQGLYLGXDO SUDFWLFH DQG SHUVRQDO UHÀHFWLRQV DERXW the program, the use of log books was very inconsistent and did not allow for compilation of practice data. Comments ZHUH H[WUDFWHG IURP SRVW LQWHUYHQWLRQ TXHVWLRQQDLUHV DQG from notes taken by instructors during or immediately after mindfulness sessions based on group discussions. Study SDUWLFLSDQWV UHSRUWHG QXPHURXV EHQH¿WV DQG SRVLWLYH RXWcomes with very few negative comments. For instance, one participant reported (translation from French): “My pain isn’t less intense, but my relation to it has changed. Now I am able to live and respond to my pain more easily”. Another wrote: “My biggest discovery during this program was to realize the impact that emotions can have on the body”. 2QH SDUWLFLSDQW H[SODLQHG ‡%HIRUH , ZRXOG GULQN WR QXPE my pain. During the course of this program, I learned that there are other ways to cope and live with my pain. Since then, I stopped drinking and I can now stay with, accept and bring compassion to my pain”. Finally, one participant PHQWLRQHG ‡, DP OHVV DQ[LRXV DQG , IHHO WKDW , KDYH PRUH tools to help me deal with stress. I don’t think about my VFKRRO H[DPV WZR ZHHNV DKHDG RI WLPH DQ\PRUH LQVWHDG I focus on what I can do now to prepare… and I breathe.” Other cited advantages and emerging themes associated with the program included: making new friends through the program, getting to know other teenagers living with similar conditions, better social skills, increased school attendance and feeling less tired during the day, increased awareness and appreciation of the present moment, feeling more UHOD[HG DQG KDYLQJ EHWWHU VHOI UHJXODWLRQ HPRWLRQ FRQWURO

Average number of weekly home practices reported in post-intervention questionnaires was four per week (range 1-10): SDUWLFLSDQWV SUDFWLFHG RQ DYHUDJH RQFH SHU ZHHN SDUWLFLSDQWV SUDFWLFHG WZR WR WKUHH WLPHV SHU ZHHN SDUWLFLSDQWV SUDFWLFHG IRXU WR VL[WLPHV SHU ZHHN DQG SDUticipants practiced seven or more times per week. Average duration of individual home practices was of eight minutes: RQH WR ¿YH PLQXWHV IRU SDUWLFLSDQWV VL[WR ¿IWHHQ PLQXWHV IRU SDUWLFLSDQWV VL[WHQ WR WZHQW\ ¿YH PLQXWHV IRU SDUWLFLSDQWV DQG PRUH WKDQ WZHQW\ ¿YH PLQXWHV IRU SDUWLFLSDQWV 7KH QDWXUH RI SUDFWLFHV ZDV DV IROORZV (from most frequent to least frequent): informal practices during normal daily activities such as brushing teeth, waiting for the bus, formal sitting meditations, body scan, $OO QLQHWHHQ SDUWLFLSDQWV ZKR FRPSOHWHG WKH 0%, UHSRUWHG D VLJQL¿FDQW SRVLtive change in the way they coped with pain. This change ZDV ‡VPDOO RU PHGLXP· IRU SDUWLFLSDQWV DQG ‡ELJ RU YHU\ ELJ· IRU 0RVW SDUWLFLSDQWV UHSRUWHG D VLJQL¿FDQW

Discussion

between 17:30 and 19:00 (data not shown). In our study, WKH VLJQL¿FDQW UHGXFWLRQV LQ VDOLYDU\ FRUWLVRO OHYHOV IURP 17:30 to 19:00 suggest that MBIs might have an important bio-physiological impact in youth with chronic pain. The ODFN RI VLJQL¿FDQW EDVHOLQH FKDQJH LQ SUH SRVW 0%, FRUWLVRO OHYHOV EHWZHHQ WKH ¿UVW 0%, VHVVLRQ DQG WKH HLJKWK session seem to indicate that these changes are of short duration. As mentioned in an early study of the original 0%65 SURJUDP E\ .DEDW =LQQ .DEDW =LQQ /LSZRUWK Burney, 1985), our data support the assumption that participants would need to practice mindfulness on a regular daily EDVLV WR EH DEOH WR VHH VXVWDLQHG EHQH¿WV 8QIRUWXQDWHO\ the large number of uninterpretable saliva samples could have impacted the data on cortisol. This could have been remediated by using Salivette® devices containing citrate WR VWLPXODWH VDOLYD SURGXFWLRQ *DOODJKHU /HLWFK 0DVVH\ 0F$OLVWHU :LOOLDPV <RXQJ 1HYHUWKHOHVV LW LV ZRUWK QRWLQJ WKDW WKH HuFW VL]H IRU VDOLYDU\ FRUWLVRO ZDV large, which strengthens our results.

There are other limitations to this study. First, we did not track long-term changes. The latest measurement, ten weeks SRVW 0%, LQ WKH H[SHULPHQWDO JURXS GLG QRW VKRZ DQ\ VLJ-QL¿FDQW FKDQJHV LQ EDVHOLQH PHDVXUHPHQW VFRUHV 6HFRQG our design did not include a standardized assessment of mindfulness or daily practice measures which could have been useful to better describe the integration of mindfulness in daily life. Third, even though the study was open to both males and females, only females were enrolled, limiting H[WHUQDO YDOLGLW\ DQG VXJJHVWLQJ D SRWHQWLDO VHOHFWLRQ ELDV Fourth, our clinical population (i.e. pain conditions) was highly heterogeneous. This could limit the conclusions and the reproducibility of this study. Fifth, due to budgetary and time limitations, control values for salivary cortisol levels were taken from young adults and not from adolescents. In addition, the number of samples per participant were limited: it would have been more informative to gather a larger number of saliva samples from each participant, throughout WKH GD\ RQ WKH ¿UVW DQG ODVW GD\ RI WKH 0%, DV VXJJHVWHG elsewhere (Matousek et al., 2010). Lastly, the lack of an attention-control group represents another important limitation of our study design. As a subsequent step, a head to head trial with CBT or dialectical behavioural therapy as a comparative group may have been informative (Hatchard, /HSDJH +XWWRQ 6NLGPRUH 3RXOLQ DV WKH DEVHQFH RI DQ DFWLYH FRQWURO JURXS PDNHV LW GLvFXOW WR GLVWLQJXLVK WKH WKHUDSHXWLF EHQH¿WV RI EHLQJ LQ D JURXS VHWWLQJ IURP WKH impact of the MBI itself.

Conclusion

&KURQLF SDLQ LQ DGROHVFHQWV LV D VLJQL¿FDQW FOLQLFDO SURE-OHP ZLWK PDQ\ FRPRUELGLWLHV DQG VLJQL¿FDQW LPSDLUPHQWV

one-year follow-up. Journal of Psychosomatic Research, 74(1), 31-40.
GRL M MSV\FKRUHV
*DOODJKHU 3 /HLWFK 0 0 0DVVH\ $ (0F$OOLVWHU
:LOOLDPV 5 + <RXQJ $ + $VVHVVLQJ FRUWLVRO DQG
GHK\GURHSLDQGURVWHURQH '+($ LQ VDOLYD (uHFWV RI FROOHFWLRQ
method. Journal of Psychopharmacology, 20(5), 643-649.
GRL
*H[ )DEU\ 0 -HUPDQQ) .RVHO 0 5RVVLHU 0) 9DQ GHU /LQGHQ
0 %HUWVFK\ * $XEU\ - 0 6DOLYDU\ FRUWLVRO SUR¿OHV LQ
patients remitted from recurrent depression: One-year follow-up of
a mindfulness-based cognitive therapy trial. Journal of Psychiatric
Research, 46 GRL M MSV\FKLUHV
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A randomized, cntrfolsedpilot studyt of mindfulness-basedstpresc0

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bodytand (min to facetstpres,cpain,tand ilulnes. Newl)>387(Y)99.9(ork, NY)91.5(: Delal6)]TJ/C21 1 Tf0 -1.255 TD<3033<008000450011000F0
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Q 0E UW / 6DQ RUHO FQ

li,KSNch,kLrovela, D. J. (2001). Changes in (pin coping,)

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(pin in childrentand adolescents revisited:t)57.9(A)55(systemansc review)66(.)>]TJ/T2 1 TfPain,t152 0PÀ¡PPLEHOLQ
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1),eenagers with cancer.