EAF
European Achondroplasia Forum

2021

Cormier-Daire *et al. Orphanet J Rare Dis* (2021) 16:333
https://doi.org/10.1186/s13023-021-01971-6

Orphanet Journal of Rare Diseases

POSITION STATEMENT Open Access

The first European consensus on principles of management for achondroplasia

Valerie Cormier-Daire[1], Moeenaldeen AlSayed[2,3], Tawfeg Ben-Omran[4], Sérgio Bernardo de Sousa[5,6], Silvio Boero[7], Svein O. Fredwall[8], Encarna Guillen-Navarro[9], Melita Irving[10], Christian Lampe[11], Mohamad Maghnie[12], Geert Mortier[13], Zagorka Peijin[14] and Klaus Mohnike[15*]

Table 1 The 2020 EAF guiding principles of management for achondroplasia

Item	Guiding principle	Vote
A	Achondroplasia is a lifelong condition requiring lifelong management by an experienced MDT, led by physicians/clinicians experienced in achondroplasia management. Close monitoring during the first 2 years of life is critical	92
B	When a diagnosis of achondroplasia is made or suspected, either in utero or after birth, the family should be referred as soon as possible to a physician experienced in achondroplasia to discuss the prognosis and management of the condition	100
C	Decisions around management should be made in the MDT setting jointly with the person with achondroplasia and/or their family	100
D	The primary goals of management are to enable anticipation, identification and treatment of problems, provide education and support to encourage a healthy lifestyle, positive self-esteem and mental health, autonomy and independence	100
E	Patients should have access to a variety of adaptive measures, support to ensure proper usage and access to approved treatment options as they become available	91
F	Regular monitoring in adolescence and adulthood should continue under an MDT with expertise in achondroplasia management. Care should include genetic counselling, transition to adulthood, psychosexual well-being and management of pregnancy	100

EAF
European Achondroplasia Forum

2022

Fredwall *et al.*
Orphanet Journal of Rare Diseases (2022) 17:318
https://doi.org/10.1186/s13023-022-02479-3

Orphanet Journal of Rare Diseases

RESEARCH Open Access

Optimising care and follow-up of adults with achondroplasia

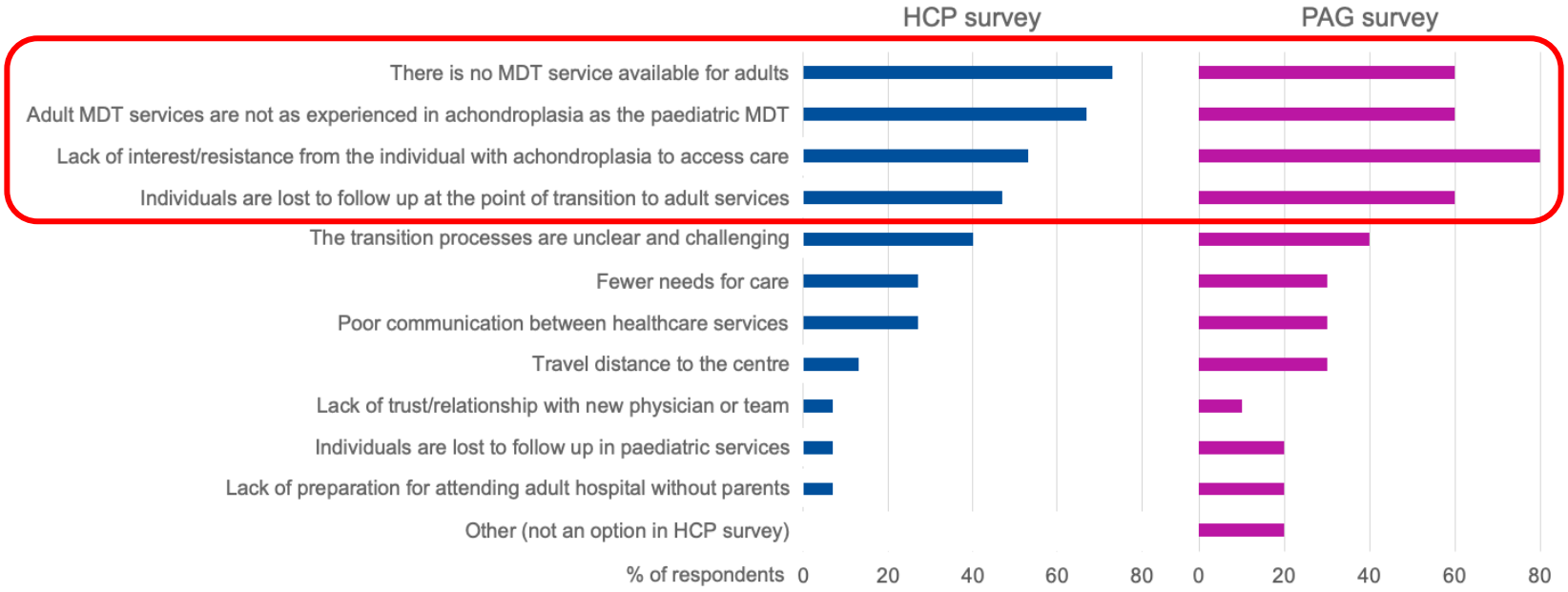
Svein Fredwall[1*], Yana Allum[2], Moeenaldeen AlSayed[3,4], Inês Alves[5], Tawfeg Ben-Omran[6], Silvio Boero[7], Valerie Cormier-Daire[8], Encarna Guillen-Navarro[9,10], Melita Irving[11], Christian Lampe[12], Mohamad Maghnie[13,14], Klaus Mohnike[15], Geert Mortier[16], Sérgio B. Sousa[17,18] and Michael Wright[19]

Online survey

Respondents:

- 16 healthcare professionals (10 countries)
- 19 PAG respondents (11 countries)

Key barriers to effective care of adults

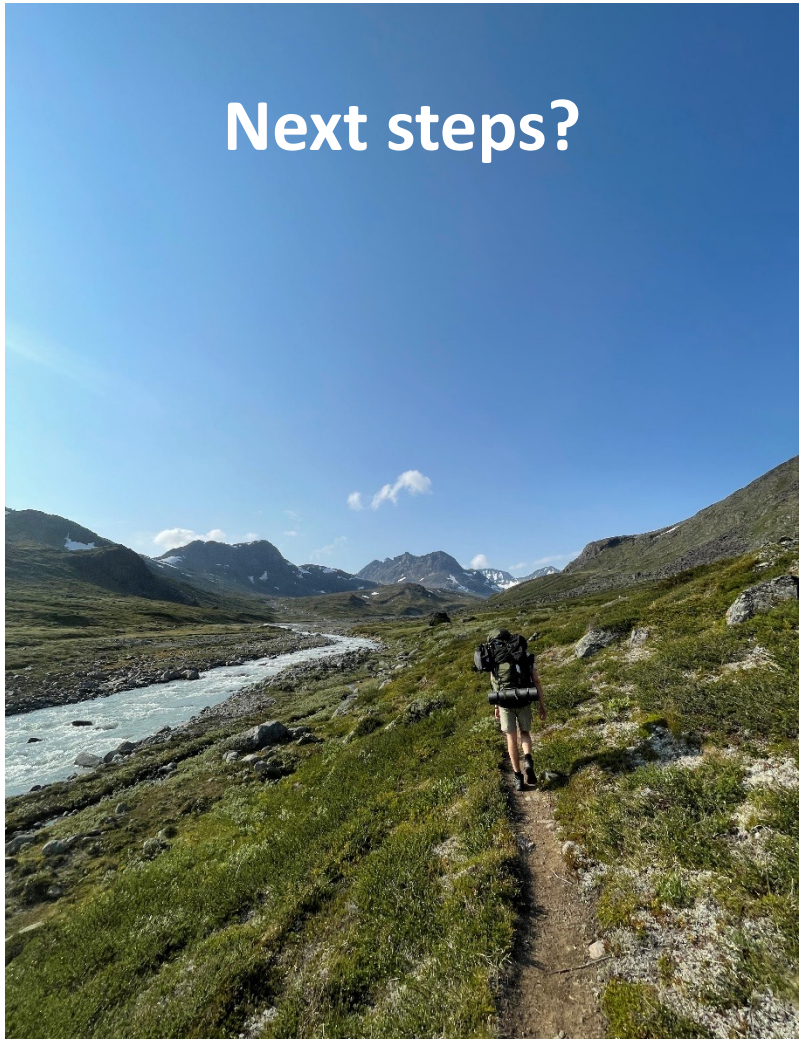


Conclusion

"….we are a long way from a standardised approach"

"It is important to understand current practices and care provision from the perspectives of both the healthcare provider and the recipients of care".

"It is also crucial to ensure that barriers to optimal care are identified and addressed"

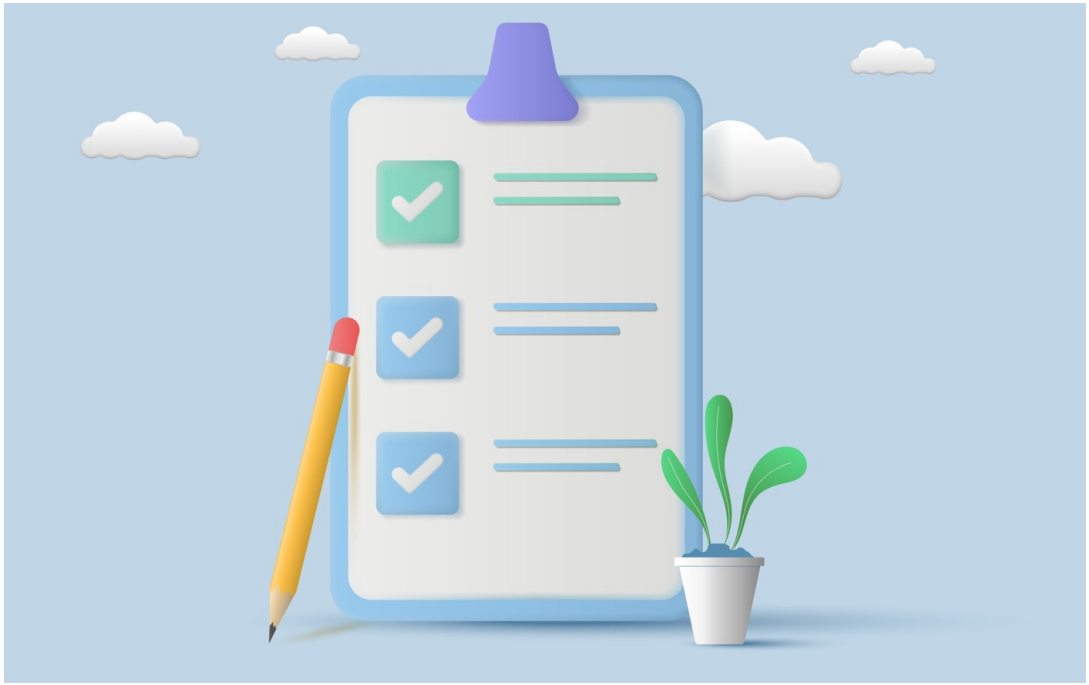


Agenda

Saturday 22nd April, 09:00–12:00

Time	Topic	Presenter
09:00	Welcome and Introductions	Svein Fredwall
09:10	**Considerations for the Transition from Paediatric to Adult Care in Achondroplasia** • What we've established in childhood • Focus on mid-late childhood • Gap between paediatric, knowledgeable MDT and primary care as an adult	Melita Irving
09:30	**Challenges and Obstacles to Achondroplasia Care After Childhood – Perspectives from a Large Patient Organisation** • Why are people reluctant to access care? • Focus on spinal symptoms v important • Talk about different age groups	Florian Innig
09:50	**Spinal Issues in Adolescents and Adults with Achondroplasia**	Philip Kunkel
10:10	**Why Should Adolescents and Adults with Achondroplasia have Access to MDT Follow-up?**	Svein Fredwall
10:30	Coffee break	
10:45	Discussion	Moderated by Svein Fredwall
11:55	Closing remarks	Svein Fredwall

Patient held checklist



EAF: Advances in Achondroplasia 2023

Why Should Adolescents and Adults with Achondroplasia have Access to MDT Follow-up?

Svein O. Fredwall

MD, PhD, Medical advisor

TRS National Resource Centre for Rare Disorders,

Sunnaas Rehabilitation Hospital

Norway

STIFTELSEN DAM

UiO : Faculty of Medicine
University of Oslo

Lovisenberg

Oslo University Hospital

TRS NATIONAL RESOURCE CENTRE FOR RARE DISORDERS
Sunnaas Rehabilitation Hospital

No disclosures

Potential medical complications in children with achondroplasia

2012

Review

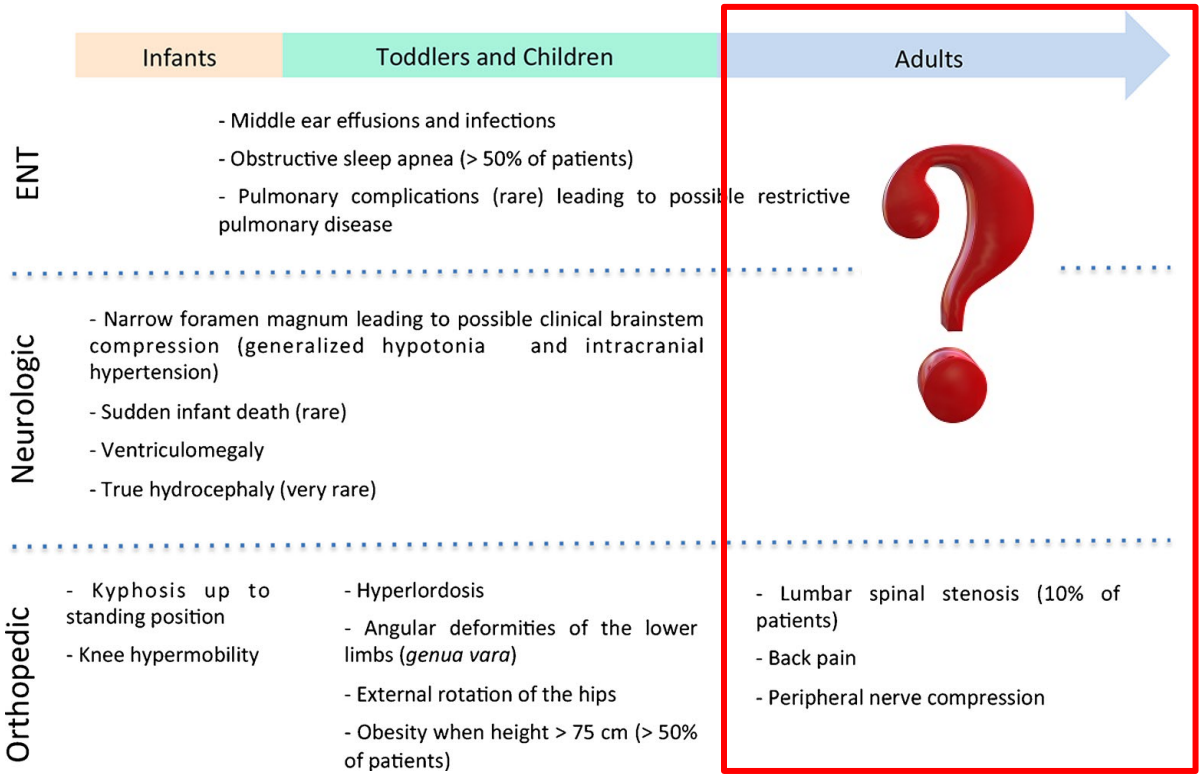
Clinical management of achondroplasia

M J Wright,[1] M D Irving[2]

Box 2 Complications of achondroplasia (%) in childhood

- Neurological
  - Foramen magnum compression (5–10%)
  - Craniocervical instability (very rare)
  - Symptomatic hydrocephalus (6%)
- Orthopaedic
  - Progressive, unresolving thoracolumbar kyphosis
  - Decreased range of movement, elbows and hips
  - Tibial bowing (10%)
  - Symptomatic lumbar spinal stenosis (20%)
- ENT
  - Recurrent otitis media (89%)
  - Adenotonsillar hypertrophy (25%)
- Dental
  - Dental overcrowding (>50%)
- Respiratory
  - Sleep apnoea (75%)
- Growth
  - Short stature
  - Increased body mass index
- Development
  - Comparative motor delay
  - Speech delay (25%)
  - Conductive hearing loss (40%)
- Activities of daily living
  - Restricted through short stature, rhizomelic shortening of upper limbs
- Pyschosocial impact for child and family

Review 2017



Unger, S., Bonafé, L., & Gouze, E. (2017). Current Care and Investigational Therapies in Achondroplasia. *Current osteoporosis reports*, *15*(2), 53–60

The Norwegian Adult Achondroplasia Study (2017–2019)

- 50 adult participants
- Mean and median age: 41 y (range 16–87)
- Population-based (76% inclusion rate)

- Symptomatic spinal stenosis
- Obstructive sleep apnoea
- Cardiovascular risk
- Hearing loss
- Physical functioning
- Activities of daily living
- Pain

Fredwall et al. Orphanet Journal of Rare Diseases (2020) 15:123
https://doi.org/10.1186/s13023-020-01397-6

Orphanet Journal of Rare Diseases

RESEARCH Open Access

High prevalence of symptomatic spinal stenosis in Norwegian adults with achondroplasia: a population-based study

Svein O. Fredwall[1,2*], Unni Steen[1], Olga de Vries[1], Cecilie F. Rustad[3], Heidi Beate Eggesbø[4], Harald Weedon-Fekjær[5], Ingeborg B. Lidal[1], Ravi Savarirayan[6] and Grethe Månum[2,7]

Genetics inMedicine

www.nature.com/gim

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ARTICLE

Cardiovascular risk factors and body composition in adults with achondroplasia

Svein O. Fredwall, MD[1,2✉], Jennifer Linge, MSc[3,4], Olof Dahlqvist Leinhard, PhD[3,4,5], Lisa Kjønigsen, MSc[6], Heidi Beate Eggesbø, MD, PhD[6], Harald Weedon-Fekjær, PhD[7], Ingeborg Beate Lidal, MD, PhD[1], Grethe Månum, MD, PhD[8], Ravi Savarirayan, MBBS, MD[9] and Serena Tonstad, MD, PhD[10]

Received: 30 November 2018 | Revised: 17 April 2019 | Accepted: 5 June 2019
DOI: 10.1002/ajmg.a.61272

ORIGINAL ARTICLE

American Journal of Medical Genetics Part A WILEY

Anthropometrics, diet, and resting energy expenditure in Norwegian adults with achondroplasia

Andrea Madsen RD[1] | Svein O. Fredwall MD[2,3] | Grethe Maanum MD PhD[4] | Christine Henriksen RD PhD[1] | Hanne B. Slettahjell RD[4]

Received: 4 May 2020 | Revised: 11 December 2020 | Accepted: 13 December 2020
DOI: 10.1002/ajmg.a.62055

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ORIGINAL ARTICLE

American Journal of Medical Genetics Part A WILEY

Physical fitness and activity level in Norwegian adults with achondroplasia

Olga Marieke de Vries[1] | Heidi Johansen[1] | Svein Otto Fredwall[1,2]

Fredwall et al. Orphanet J Rare Dis (2021) 16:156
https://doi.org/10.1186/s13023-021-01792-7

Orphanet Journal of Rare Diseases

RESEARCH Open Access

Obstructive sleep apnea in Norwegian adults with achondroplasia: a population-based study

Svein O. Fredwall[1,2*], Britt Øverland[3], Hanne Berdal[3], Søren Berg[3], Harald Weedon-Fekjær[4], Ingeborg B. Lidal[1], Ravi Savarirayan[5†] and Grethe Månum[2,6†]

Fredwall et al. Orphanet J Rare Dis (2021) 16:468
https://doi.org/10.1186/s13023-021-02095-7

Orphanet Journal of Rare Diseases

RESEARCH Open Access

Hearing loss in Norwegian adults with achondroplasia

Svein O. Fredwall[1,2*], Björn Åberg[3], Hanne Berdal[3], Ravi Savarirayan[4] and Jorunn Solheim[3]

Key findings

Symptomatic spinal stenosis	≈ 70%
Impact on physical functioning and daily activities	High
Chronic pain	≈ 70%
Obstructive sleep apnoea	≈ 60%
Hypertension (in men)	≈ 50%
Hearing loss	≈ 50%
Lipids/cardiovascular risk & type 2 diabetes	Low

Stenosis vs non-stenosis group

Stenosis group (n=34)

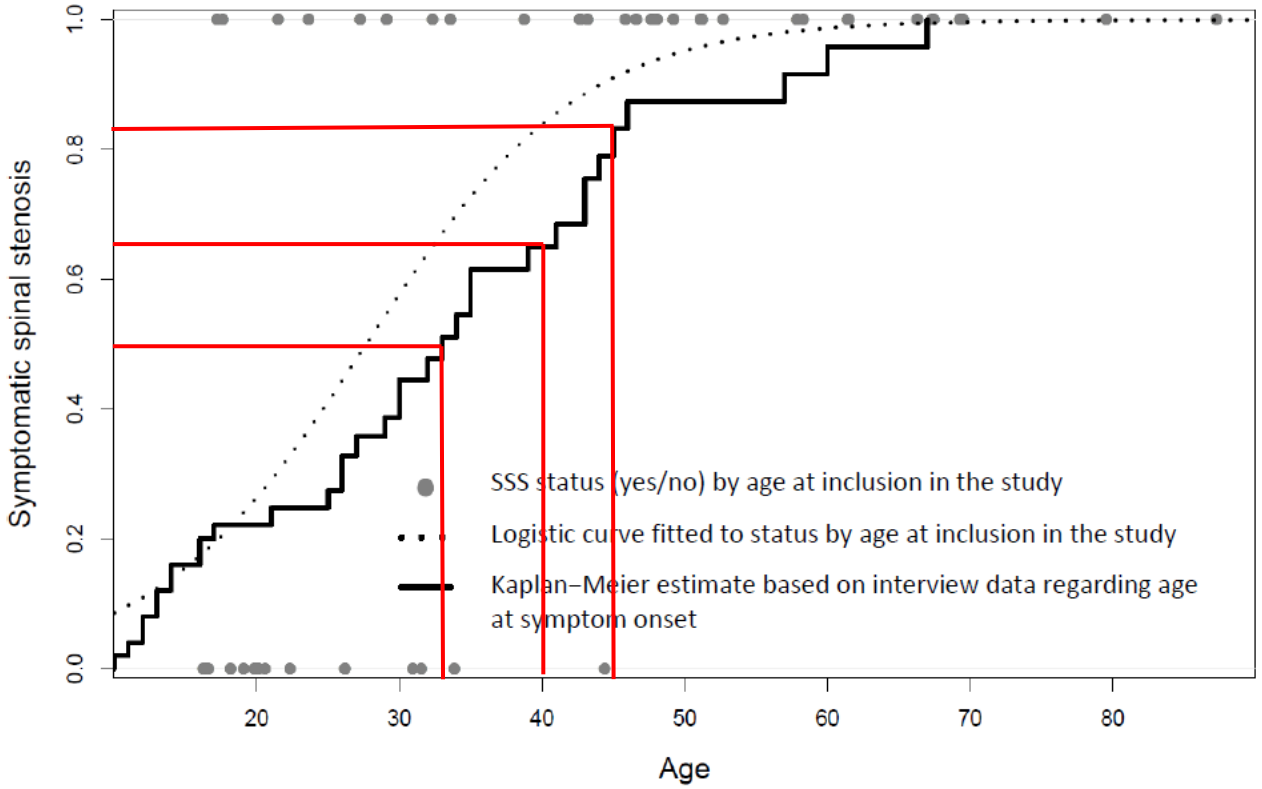
- Age at first symptom onset: range 10–67 years
- 82% (28/34) had undergone at least one spinal decompression

- 41% (14/34) reported persistent urinary incontinence
- 23% (7/34) reported persistent bowel incontinence
- Work participation: 27%

Non-stenosis group (n=16)

- None reported neurological complications
- Work participation: 94%

Estimated likelihood of symptomatic stenosis by age

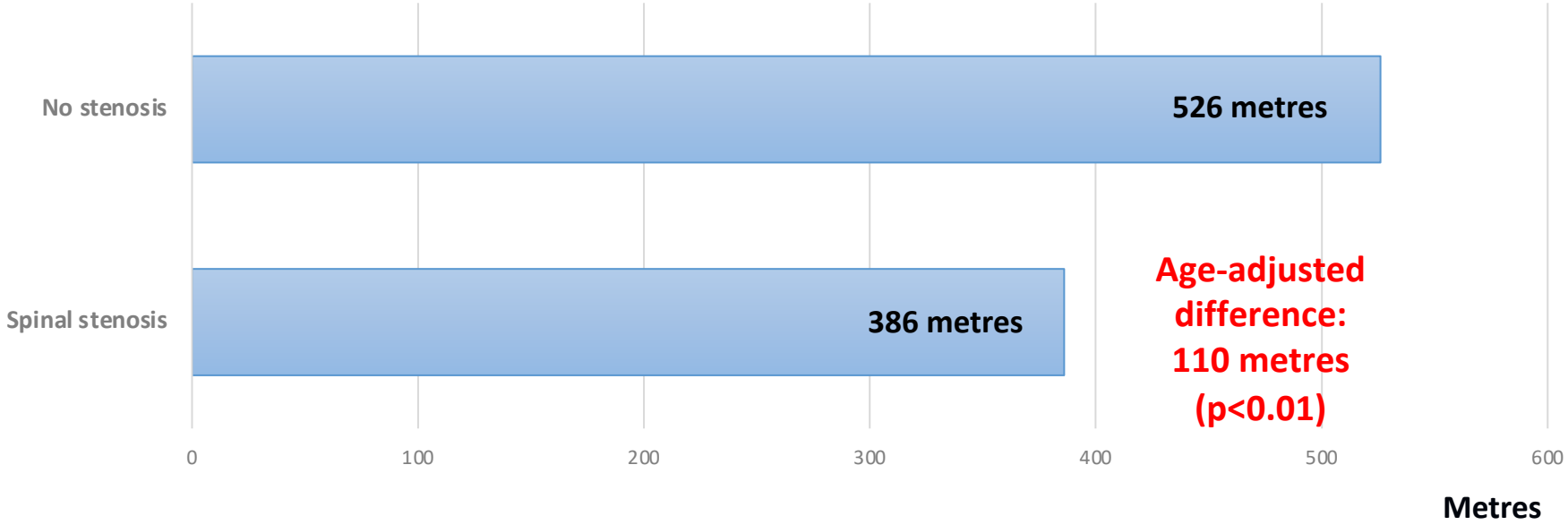


Median:
33 y (95% CI 29–43)

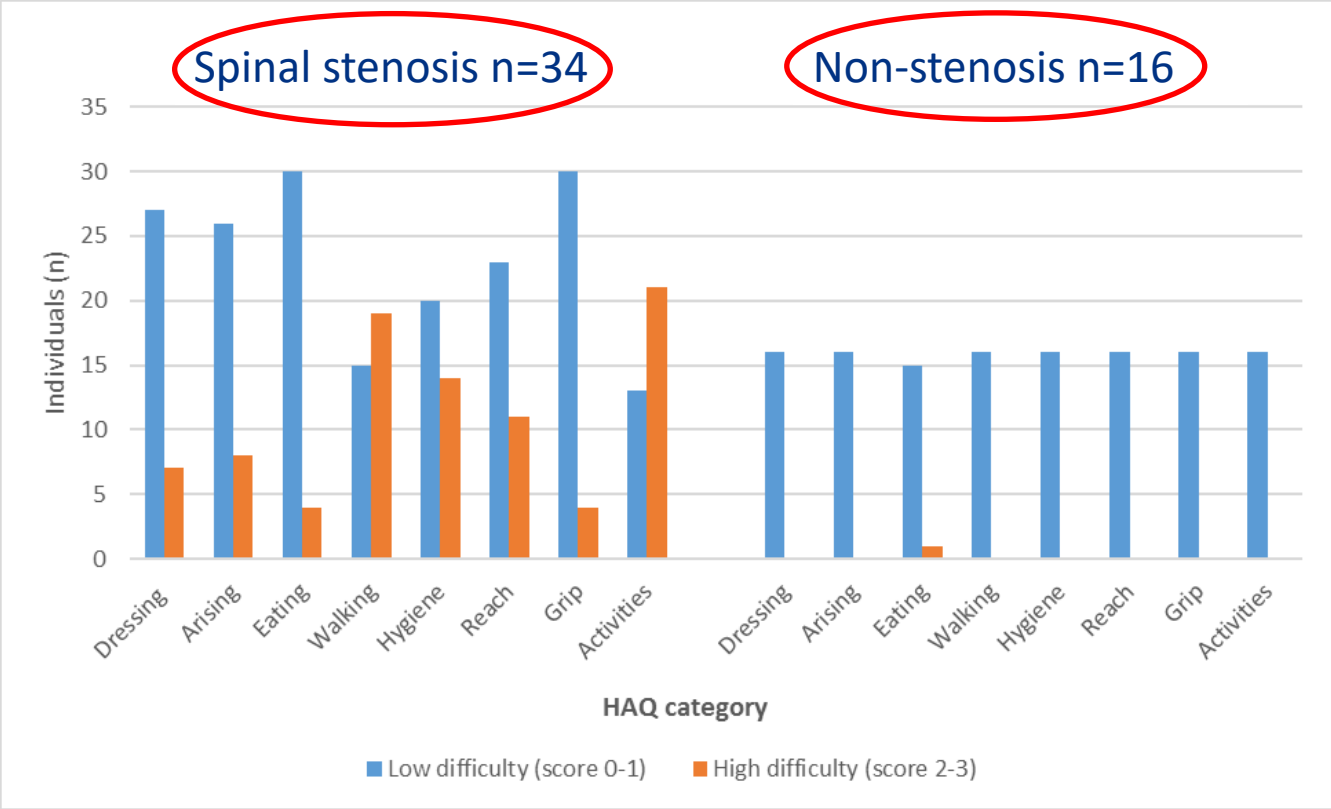
Age 40 y:
65% (95% CI 44–78)

Age 45 y:
83% (95% CI 62–93)

Functional walking capacity (6MWT)

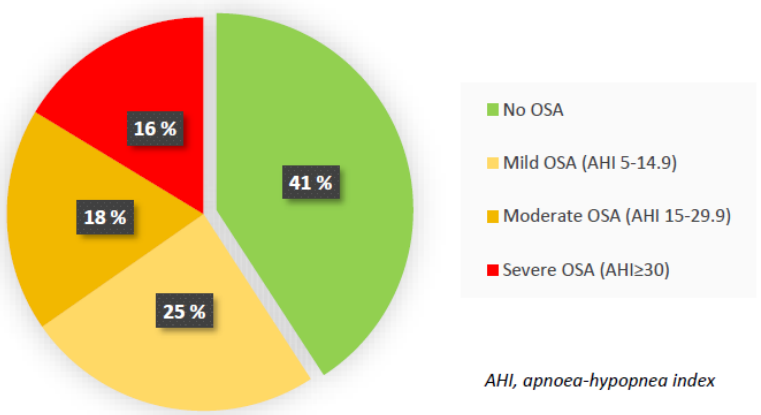


Impact on daily activities (ADL)



Obstructive sleep apnoea (OSA)

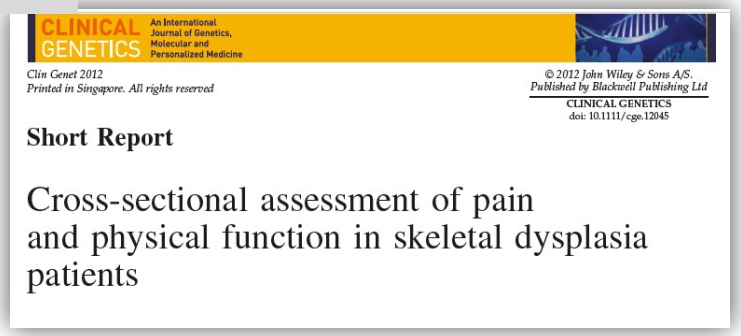
- **59%** (29/49) had OSA (vs. general adult population: 4–8%)
- 2/3 had moderate – severe OSA (AHI ≥ 15)
- 48% were previously undiagnosed with OSA
- Prevalence in men > women (75% vs 45%)



AHI, apnoea-hypopnea index

Findings supported by other studies….

2012



CLINICAL GENETICS An International Journal of Genetics, Molecular and Personalized Medicine

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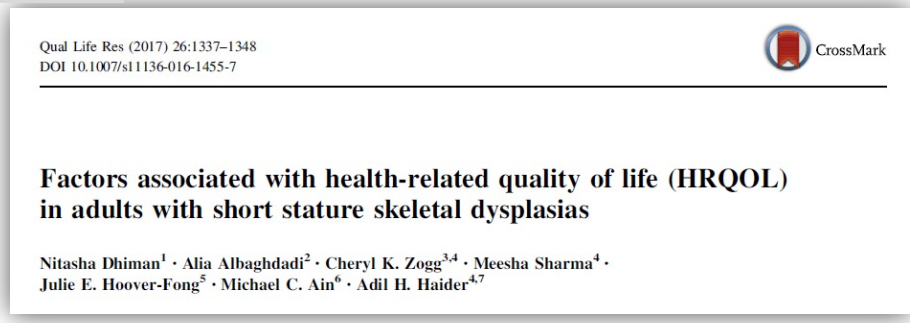
doi: 10.1111/cge.12045

Short Report

Cross-sectional assessment of pain and physical function in skeletal dysplasia patients

2017



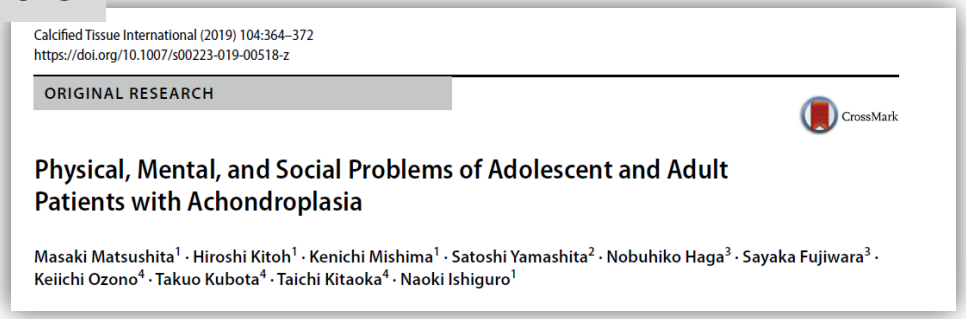
Qual Life Res (2017) 26:1337–1348
DOI 10.1007/s11136-016-1455-7

CrossMark

Factors associated with health-related quality of life (HRQOL) in adults with short stature skeletal dysplasias

Nitasha Dhiman[1] · Alia Albaghdadi[2] · Cheryl K. Zogg[3,4] · Meesha Sharma[4] · Julie E. Hoover-Fong[5] · Michael C. Ain[6] · Adil H. Haider[4,7]

2019



Calcified Tissue International (2019) 104:364–372
https://doi.org/10.1007/s00223-019-00518-z

ORIGINAL RESEARCH

CrossMark

Physical, Mental, and Social Problems of Adolescent and Adult Patients with Achondroplasia

Masaki Matsushita[1] · Hiroshi Kitoh[1] · Kenichi Mishima[1] · Satoshi Yamashita[2] · Nobuhiko Haga[3] · Sayaka Fujiwara[3] · Keiichi Ozono[4] · Takuo Kubota[4] · Taichi Kitaoka[4] · Naoki Ishiguro[1]

2019

Received: 2 August 2019 | Revised: 3 October 2019 | Accepted: 18 October 2019
DOI: 10.1002/ajmg.a.61402

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ORIGINAL ARTICLE

AMERICAN JOURNAL OF medical genetics PART A WILEY

Blood pressure in adults with short stature skeletal dysplasias

Julie Hoover-Fong[1] | Adekemi Yewande Alade[2] | Michael Ain[3] | Ivor Berkowitz[4] | Michael Bober[5] | Erin Carter[6] | Jacqueline Hecht[7] | Dan Hoerschemeyer[8] | Debra Krakow[9] | Gretchen MacCarrick[10] | William G. Mackenzie[11] | Roberto Mendoza[12] | Ericka Okenfuss[13] | Deirdre Popplewell[13] | Cathleen Raggio[6] | Kerry Schulze[14] | John McGready[14]

2020

Received: 17 March 2020 | Revised: 1 July 2020 | Accepted: 10 July 2020
DOI: 10.1002/ajmg.a.61825

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AMERICAN JOURNAL OF medical genetics PART A WILEY

ORIGINAL ARTICLE

Natural history of achondroplasia: A retrospective review of longitudinal clinical data

Ericka Okenfuss[1] | Billur Moghaddam[1] | Andrew L. Avins[2]

2021

Genetics inMedicine
www.nature.com/gim

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ARTICLE

Achondroplasia Natural History Study (CLARITY): a multicenter retrospective cohort study of achondroplasia in the United States

Julie E. Hoover-Fong[1], Adekemi Y. Alade[1,7], S. Shahrukh Hashmi[2], Jacqueline T. Hecht[2,3], Janet M. Legare[4], Mary Ellen Little[5], Chengxin Liu[1], John McGready[1,6], Peggy Modaff[4], Richard M. Pauli[4], David F. Rodriguez-Buritica[2], Kerry J. Schulze[1,6], Maria Elena Sema[2], Cory J. Smid[4,8] and Michael B. Bober[5]

2023

Maghnie et al.
Orphanet Journal of Rare Diseases (2023) 18:56
https://doi.org/10.1186/s13023-023-02652-2

Orphanet Journal of Rare Diseases

RESEARCH Open Access

Check for updates

Lifetime impact of achondroplasia study in Europe (LIAISE): findings from a multinational observational study

Mohamad Maghnie[1,2], Oliver Semler[3,4], Encarna Guillen-Navarro[3,5,6], Angelo Selicorni[7], Karen E. Heath[3,8,6], Gabriele Haeusler[9], Lars Hagenäs[3,10], Andrea Merker[11], Antonio Leiva-Gea[12], Vanesa López González[3,5,6], Adalbert Raimann[9], Mirko Rehberg[3,4], Fernando Santos-Simarro[3,8], Diana-Alexandra Ertl[9], Pernille Axél Gregersen[13], Roberta Onesimo[14], Erik Landfeldt[15], James Jarrett[16], Jennifer Quinn[16], Richard Rowell[17], Jeanne Pimenta[16], Shelda Cohen[16], Thomas Butt[16], Renée Shediac[17], Swati Mukherjee[16] and Klaus Mohnike[3,18*]

Some key findings in other recent studies on adults (1)

Authors (year)	Adults (n)	Age, y	Some Key Findings
Alade et al (2012)	159	35.5 ± 16.7	• 64% reported chronic pain • Daily function and independent walking markedly impaired
Dhiman et al (2017)	106	≥ 18 y	• Pain prevalence 74.5%
Matsushita et al (2019)	108	20–67	Proportion undergone spine surgery: • 57% in the age group 40–49 y • 88% in the age group 50–59 y
Hoover-Fong et al (2019)	234	38.6 (SD 14.1)	• 44% were hypertensive • Males > females (56% vs 35%)

Some key findings in other recent studies on adults (2)

Authors (year)	Adults (n)	Age, y (range)	Some Key Findings
Okenfuss et al (2020)	114	Mean 12.6	• 18% had cervical spinal stenosis • 42% had lumbar spinal stenosis • 69% overall (children and adults) had OSA
Hoover-Fong et al (2021) The **CLARITY** Study	1374	15.4 ± 13.9 (0–79.7)	• 80% had ≥ 1 achondroplasia-related surgery • 38% had moderate to severe OSA
Magnie et al (2023) The **LIASE** Study	186 Adults: 84 (45%)	21.7 ± 17.3 (5.0 – 84.4)	• 95% ≥ 1 medical complication • Highest complication rate < 10 y and > 40 y • 72% ≥ 1 surgical procedure • Impaired mobility • Pain prevalence 70.3%

Psychosocial health in adults with achondroplasia

- Psychosocial health reported lower in adults with achondroplasia
- More anxiety, depression, and low self-esteem
- Lower work participation

1. *Jennings SE, Ditro CP, Bober MB, et al. Prevalence of mental health conditions and pain in adults with skeletal dysplasia. Qual Life Res. 2019;28(6):1457-1464*
2. *Yonko EA, Emanuel JS, Carter EM, Raggio CL. Quality of life in adults with achondroplasia in the United States. Am J Med Genet A. 2021;185(3):695-701*
3. *Fredwall SO, Steen U, de Vries O, et al. High prevalence of symptomatic spinal stenosis in Norwegian adults with achondroplasia: a population-based study Orphanet J Rare Dis. 2020;15(1):123.*
4. *Maghnie M, Semler O, Guillen-Navarro E, et al. Lifetime impact of achondroplasia study in Europe (LIAISE): findings from a multinational observational study. Orphanet J Rare Dis. 2023;18(1):56.*

Conclusion and implications for clinical practice

- ✓ Achondroplasia is a lifelong condition with a high burden of medical complications
- ✓ Impact on physical functioning, daily activities, pain, and psychosocial health

Demonstrating the need for lifelong care

- Multidisciplinary
- Anticipatory
- Lifelong

Nov 2021

CONSENSUS STATEMENT

Check for updates

International Consensus Statement on the diagnosis, multidisciplinary management and lifelong care of individuals with achondroplasia

Ravi Savarirayan[1]✉, Penny Ireland[2], Melita Irving[3], Dominic Thompson[4], Inês Alves[5], Wagner A. R. Baratela[6], James Betts[7], Michael B. Bober[8], Silvio Boero[9], Jenna Briddell[8], Jeffrey Campbell[8], Philippe M. Campeau[10], Patricia Carl-Innig[11], Moira S. Cheung[3], Martyn Cobourne[12], Valérie Cormier-Daire[13], Muriel Deladure-Molla[13], Mariana del Pino[14], Heather Elphick[15], Virginia Fano[14], Brigitte Fauroux[13], Jonathan Gibbins[3], Mari L. Groves[16], Lars Hagenäs[17], Therese Hannon[18], Julie Hoover-Fong[16,19], Morrys Kaisermann[20], Antonio Leiva-Gea[21], Juan Llerena[22], William Mackenzie[8], Kenneth Martin[23], Fabio Mazzoleni[24], Sharon McDonnell[18], Maria Costanza Meazzini[25], Josef Milerad[17], Klaus Mohnike[26], Geert R. Mortier[27], Amaka Offiah[15,28], Keiichi Ozono[29], John A. Phillips III[30], Steven Powell[18], Yosha Prasad[3], Cathleen Raggio[31], Pablo Rosselli[32], Judith Rossiter[33], Angelo Selicorni[34], Marco Sessa[35], Mary Theroux[8], Matthew Thomas[18], Laura Trespedi[36], David Tunkel[16], Colin Wallis[4], Michael Wright[18], Natsuo Yasui[37] and Svein Otto Fredwall[38,39]

Recommendations (11) for adults

Recommendation 74. Ongoing back pain, combined with neurological symptoms, such as claudication, spasticity, reduced walking distance, or bladder and/or bowel dysfunction, might be related to spinal stenosis in adults with achondroplasia and an MRI scan of the entire spine should be considered[20,80,86].

Recommendation 75. In the presence of symptomatic spinal stenosis in adults with achondroplasia, where imaging demonstrates evidence of spinal cord impingement or compression, a prompt referral to a spine centre experienced in the management of spinal stenosis in achondroplasia should be considered[20,75].

Recommendation 76. In adults with achondroplasia presenting with symptoms suggestive of OSA, an overnight sleep study should be performed[81].

Recommendation 77. Blood pressure should be regularly monitored in adults with achondroplasia using a cuff that fits the arm appropriately. Blood pressure measurement on the forearm is an option when elbow contractures or rhizomelia prevents measurement at the upper arm[84,87].

Recommendation 78. Adults with achondroplasia might be at increased risk of early-onset hearing loss. There should be a low threshold for assessment of symptomatic individuals and consideration of routine screening at an earlier age than in the general population[83,88].

Recommendation 79. Pain should be monitored longitudinally in adults with achondroplasia at each medical check-up. The effect that pain has upon mood, self-care, education, employment and leisure activities in individuals with achondroplasia should be specifically examined and monitored using patient-reported outcome scales such as the Brief Pain Inventory[19,20,22,26].

Recommendation 80. Adults with achondroplasia should have routine health checks as advised for the general population in their community.

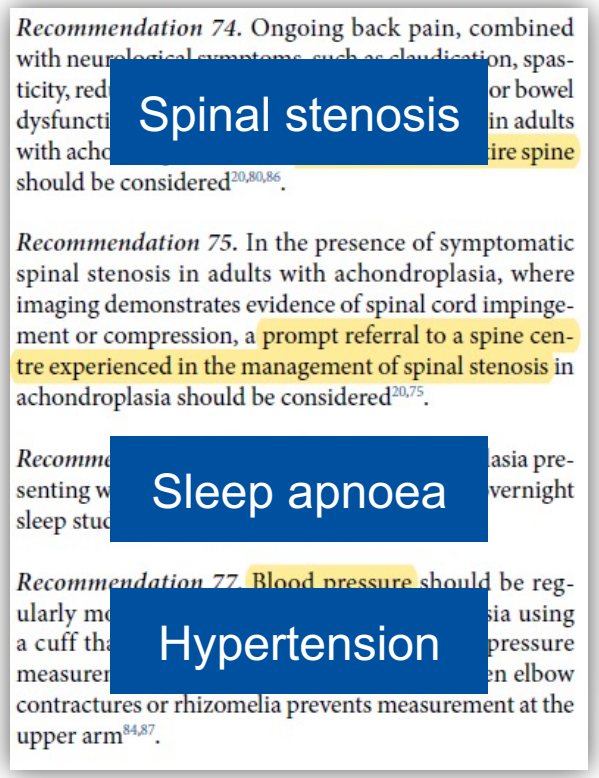
Recommendation 81. Older adolescents and adults with achondroplasia should be offered genetic counselling to provide information on reproductive options.

Recommendation 82. Adults with achondroplasia should be offered psychosocial support as part of their routine health care, which may include formal assessment by a trained professional[23,25].

Recommendation 83. Anaesthesia for people with achondroplasia should be performed by staff experienced with achondroplasia and follow consensus recommendations[12].

Recommendation 84. Aids and adaptations, including car adaptations, are required for adults with achondroplasia[20].

Recommendations (11) for adults



Recommendation 74. Ongoing back pain, combined with neurological symptoms such as claudication, spasticity, red… or bowel dysfuncti… in adults with acho… ire spine should be considered[20,80,86].

Recommendation 75. In the presence of symptomatic spinal stenosis in adults with achondroplasia, where imaging demonstrates evidence of spinal cord impingement or compression, a prompt referral to a spine centre experienced in the management of spinal stenosis in achondroplasia should be considered[20,75].

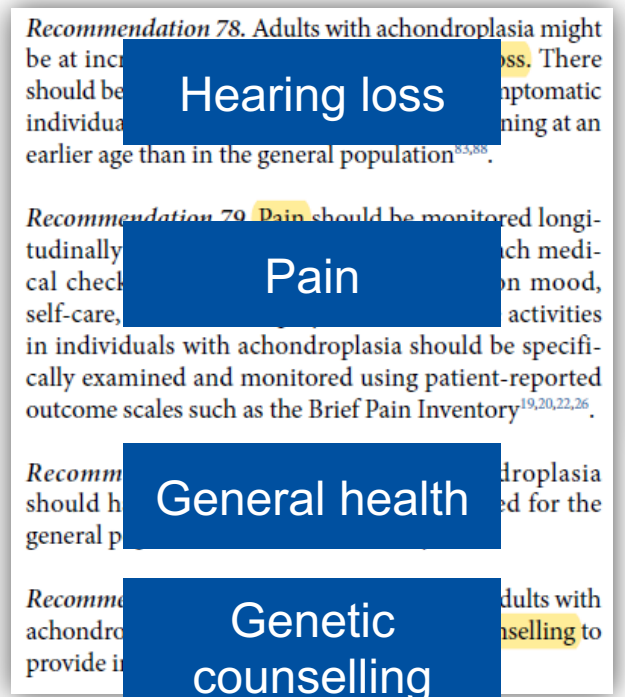
Recomm… …asia presenting w… vernight sleep stu…

Recommendation 77. Blood pressure should be regularly mo… …sia using a cuff tha… pressure measurer… …n elbow contractures or rhizomelia prevents measurement at the upper arm[84,87].

Spinal stenosis

Sleep apnoea

Hypertension



Recommendation 78. Adults with achondroplasia might be at incr… …ss. There should be … …nptomatic individua… …ning at an earlier age than in the general population[85,88].

Recommendation 79. Pain should be monitored longitudinally … …ch medical check… …n mood, self-care, … activities in individuals with achondroplasia should be specifically examined and monitored using patient-reported outcome scales such as the Brief Pain Inventory[19,20,22,26].

Recomm… …droplasia should h… …d for the general p…

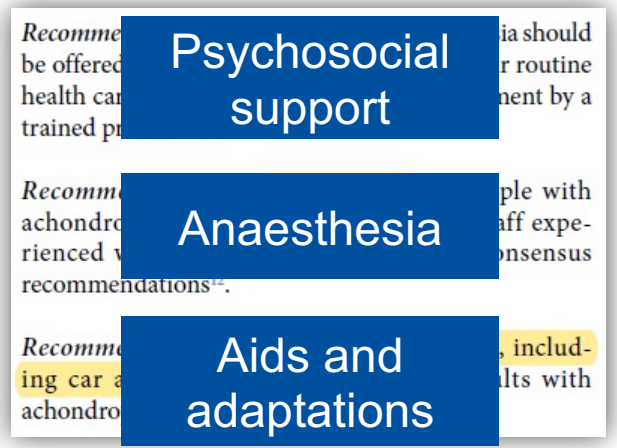
Recomm… …dults with achondro… …nselling to provide i…

Hearing loss

Pain

General health

Genetic counselling



Recomme… …ia should be offered … …r routine health ca… …ment by a trained p…

Recomm… …ple with achondro… …ff experienced … …nsensus recommendations[12].

Recomm… …, including car a… …lts with achondro…

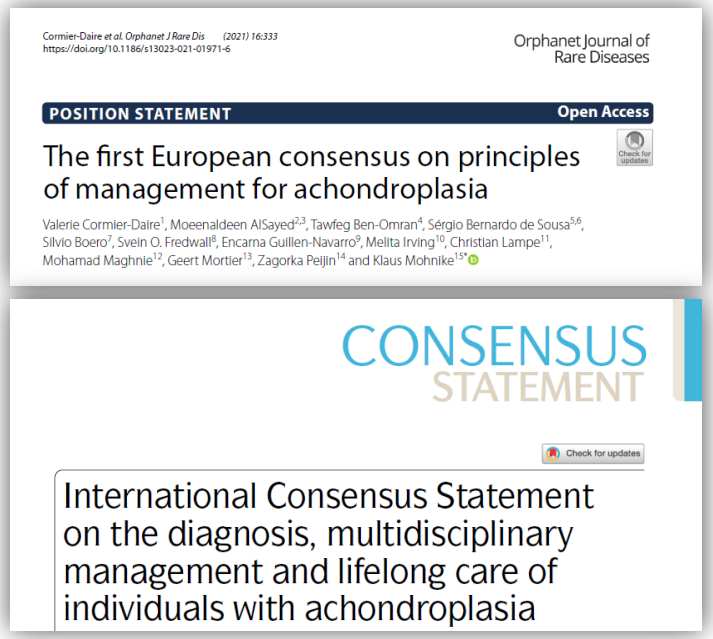
Psychosocial support

Anaesthesia

Aids and adaptations

Implementation

From Clinical Guidelines to Clinical Practice



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The first European consensus on principles of management for achondroplasia

Valerie Cormier-Daire[1], Moeenaldeen AlSayed[2,3], Tawfeg Ben-Omran[4], Sérgio Bernardo de Sousa[5,6], Silvio Boero[7], Svein O. Fredwall[8], Encarna Guillen-Navarro[9], Melita Irving[10], Christian Lampe[11], Mohamad Maghnie[12], Geert Mortier[13], Zagorka Peijin[14] and Klaus Mohnike[15*]

CONSENSUS STATEMENT

Check for updates

International Consensus Statement on the diagnosis, multidisciplinary management and lifelong care of individuals with achondroplasia

Discussion